ACCIDENTS IN MINES.*

IX.†

Fire-Damp Indicators.

(*Continued from page 337.*)

This indicator, which, in the form recently adopted by Mr. Blaikley, is very portable, consists of a small bellows, from which a stream of air or gas can be directed on to, first, a reed freely exposed, and, secondly, a reed of the same pitch placed at the bottom of a tube. The length of this tube is adjusted so that, when it is filled with pure air, both reeds give their natural sounds, which are consequently in unison. If now the instrument is made to operate in a vitiated atmosphere, the tube becomes filled with a gas mixture having a density differing from that of pure air, and the pitch of the sound produced by the reed attached to the tube is changed, while the pitch of the freely exposed reed remains unchanged. The two sounds being no longer in unison, beats are produced, which are easily recognized even by an unpracticed observer, unless the period of the beat becomes very long.

By counting the number of beats in a second, or by altering the length of the tube until the two sounds are again in unison, and by observing this alteration of length, data are obtained from which it is possible to infer the percentage of marsh gas present in the atmosphere, if it is known that no other gas or vapor is mixed with the air, and if the temperature remains unchanged.

In both these acoustical indicators the inference as to the composition of the atmosphere rests upon the relation between the length of a column of gas producing a sound of given pitch and the density of the gas. This length varies inversely as the square root of the density of the gas, assumed to be at a constant pressure. The composition of the atmosphere is thus to be inferred from its density, and consequently nearly the same objections apply to the acoustical indicators as to those depending on the buoyancy of the atmosphere. Their indications are, it is true, independent of changes in the pressure of the atmosphere, but these are rendered insufficient for determining the percentage of marsh gas by the presence of unknown quantities of aqueous vapor, carbonic acid and other gases, and by changes of temperature. To determine and allow for these disturbing circumstances would make the estimation of marsh gas by these instruments too complicated to be practically useful.

For the purpose of detecting whether large proportions of gas are contained in the air filling cavities, fissures, or nickings, into which it is impossible or may be dangerous to introduce a lamp, the instruments brought under our notice by Mr. John Jones and Mr. W. E. Garforth are serviceable.

Mr. Jones extracts the gas mixture from the place to be examined by means of a long and narrow exhausting syringe, which is capable of retaining a charge of compressed gas between its piston and the collar through which the piston rod works. This charge of compressed gas mixture may be, if necessary, conveyed out of the pit in the syringe, and submitted to chemical analysis, or it may be roughly tested by allowing it to escape, through a tap near the collar, into a safety lamp by a channel protected by gauze, which delivers the charge in close proximity to the flame. If the enclosed air contains a large proportion of fire-damp this will make its presence evident by increasing the flame, or by igniting in the lamp, and the experiment may be tried with perfect safety in any sheltered part of the workings, where the lamp-flame does not show a cap before the contents of the syringe are passed on to it.

For convenience of carriage, a plug may be inserted into the end of the syringe beyond its fixed valve, and a handle may be screwed over the external end of the piston rod; the syringe may then be used as a walking stick.

For extracting the gas from crevices Mr. Garforth uses a small hollow india-rubber ball provided with a metal nozzle. The ball being compressed in the hand, so as to expel the greater part of the air contained in it, the nozzle is inserted into the crevice or cavity, and the ball is then allowed to expand to its natural size. It of course becomes filled with the gas mixture existing in the place under examination, and this gas may be introduced into a safety lamp, through a gauze-protected channel, by again compressing the ball. For thus testing the gas Mr. Garforth uses a bonneted Mueseler lamp, through the oil cup of which pases, close to the wick tube, a narrow pipe containing several gauze diaphragms, and terminating below in a tube which just fits the nozzle of the india-rubber ball. The external end of this tube is closed by a spring valve, and when the nozzle is introduced it opens the valve and the gas can be forced up the pipe and on to the lamp-flame. This simple, and extremely portable apparatus seems to answer its purpose perfectly, and the addition to the lamp of the pipe above mentioned does not effect either its security or its illuminating power.

Several plans have been proposed for providing a safety lamp with some appliance which, when gas is ignited in the lamp, or when the temperature is increased by an enlargement of the flame, will cause a bell to ring, and so call attention to the state of the atmosphere. M. Somzee introduces into the gauze cap of a Mueseler lamp, outside the chimney, a compound metallic strip, either in the form of a straight bar or of a spiral, one end of which is fixed and the other free. It is intended that when the temperature of the lamp rises, in consequence of the combustion of gas, the strip shall bend, and its free end shall come in contact with a metallic stud attached to the gauze, thereby closing an electric circuit and causing a bell to ring. If the lamp is stationary the battery and bell may be simply connected with it by wires, but if the lamp is required to be moveable, a small battery and bell may be enclosed in the base of the lamp itself.

Mr. Hyde has exhibited to us an arrangement by which an alarm may be given without the aid of an electric current. A large Davy lamp is enclosed in a metal case provided with openings, which may be closed by shutters sliding in vertical grooves. When the shutters are raised air is admitted through the openings and the lamp can burn, but, when they are allowed to descend by their own weight, they close the case and the lamp is extinguished. The shutters are maintained in a raised position by a rod which passes through the oil cup and is suspended from a fixed support inside the gauze by a loop of thread. If gas becomes ignited in the lamp and this loop of thread is burnt, the shutters should fall, and in so doing cause two clock-work bells, attached to the case, to ring. The alarm is thus given and the lamp extinguished at the same time.

All these appliances for giving an alarm seem to us very untrustworthy; some are liable to come into operation from various causes when no gas is present, and others would probably fail to act until too late. If Mr. Hyde's apparatus, as at present constructed, were exposed to an explosive current, having even a very moderate velocity, an explosion would almost certainly be produced before the thread was burnt through.

Our attention has been officially called to a pamphlet in which is described an American invention named "the Electric Fire-damp Indicator."

The plan proposed consists in transmitting through the workings of a mine, automatically or at will, from a central office, a current from a Ruhmkorff's induction coil, which will produce sparks at breaks in the circuit placed in situations where gas is likely to be found. Each break in the circuit is enclosed in a small cylindrical box having its ends of double wire gauze, so that the atmosphere of the mine can circulate through the box. When the air in one of these boxes becomes explosive, and is ignited by a spark, it is assumed that the flash will not pass through the double gauze, but that the heat will be sufficient to burn a silk thread stretched across the box near the spark. The breaking of this thread liberates a clock-work arrangement which, by a second electric circuit, shows on an "annunciator" in the office the indicator which has operated, and consequently points out the part of the mine which contains an explosive gas mixture.

Passing over the difficulty, amounting almost to impossibility, of maintaining in a mine the insulation of a circuit so perfect that a high potential current will not cause a spark elsewhere than at the protected breaks, the proposed indicator is open to grave objections.

We have already pointed out, as the result of our experiments with lamps, that mixtures of fire-damp and air, which are not affected by an electric spark, may be ignited by a flame in a safety lamp; thus the atmosphere of the mine may become dangerous some time before notice of its condition will be afforded by the indicator.

Moreover, the experiments of M. Marsaut, on the ignition of explosive gas mixtures in safety lamps by means of an electric spark, show that if the box enclosing a break in the circuit be made of the dimensions suggested, the internal explosion will be communicated to the external atmosphere in many cases.

We consequently consider that the arrangements proposed in this pamphlet would be highly dangerous if they could be made practicable.

X.

Shaft Accidents.

There is no one of the dangers incident to mining operations which has been so successfully dealt with of late years as that connected with the shafts. Collisions, breakage of ropes and chains, and falling of materials and of men from the surface, or from part way down, combine to make the list of casualties, 30 years ago, a very serious one. In the British collieries and ironstone mines the average of the 10 years from 1851 to 1860, shows that one death resulted from these causes among 1,161 persons occupied. Between 1861 and 1871 the number of persons employed for one death was increased to 2,121. The years from 1870 to 1880 gave an average of one life lost for 3,557 persons, and the average of the last three years shows the notable improvement of only one death to 4,718 people employed.

The records of the metalliferous mines are far less satisfactory, as might be expected from the different circumstances under which the shafts are sunk, and from the number of persons necessarily engaged in more or less highly inclined excavations.

One principal source of the general advance in security has doubtless been the introduc-

*From "Final Report of Her Majesty's Commissioners appointed to inquire into Accidents in Mines, etc," 1886

†No. VIII is delayed by illustrations; it will be commenced in next issue.—ED. ENG. NEWS.

tion of guided shaft-cages, whether the guides have been of wood, rail-iron, or wire rope. The improvements which have been made in winding engines and pitgear generally as well as the greater care and attention on the part of both the officials and the workpeople, have also contributed to this result.

There is, perhaps, in the whole range of engineering nothing more remarkable than the small number of accidents which attend the lowering and raising of some 420,000 persons every day through shafts.

Taking as an example a case set forth at page 428 of the Evidence of our Preliminary Report:—At the Navigation and Deep Duffryn Collieries in South Wales, 1,200 men had daily for an average of four and one half days per week been lowered and raised 430 yards for twenty and eighteen years in the two pits, so that "nearly six millions of persons "had gone down and been brought up in that time without a single accident."

Mr. Bryham, of Rosebridge, has drawn with a flatsteel rope from 800 yards deep in 55 seconds, for 10 years, and from 600 yards for 11 years before, and never had a fatal accident (Preliminary Report, p. 251.)

But inasmuch as men travelling by the ropes are exposed to risks of accident, either by the rope's breaking, or by overwinding against the pulleys, many attempts have been made during the last half-century to prevent the occurrence of such accidents. The first "safety cage" prominently brought before the public was that of Mr. E. N. Fourdrinier, who received a prize-medal at the Great Exhibition of 1851 for an apparatus depending on wedges drawn in between the guides and the framework of the cage by a spring released on the breakage of the rope. Numerous contrivances had for several years before been proposed, and have continued to emanate from engineers in this country, in France, Belgium, and Germany, and many might be enumerated, more or less worthy of attention for their ingenuity. Some of them, adopted in large numbers in practice, have been so vaunted and appear at first sight to promise such important safeguards, that a close enquiry is needed to allow of an opinion being formed on their applicability.

Among the catches for safety cages, one group and apparently the earliest one, depends on the throwing out laterally of bolts intended to catch in a ratchet or ladder-way fixed on opposite sides of the pit. A second group (Fontaine and others) brings into play a pair of bars hanging in form of a chevron over the cage, and ending in strong teeth which insert themselves into the wooden conductors. A third group operates by embracing the sides or cheeks of the conductors either by excentrics or by toothed clutches brought into grip by a spring liberated as soon as the tension of the rope is relaxed by its breaking. In other forms an attempt has been made to introduce a gradual action in place of the sudden shock which would attend the use of most of the above; among these is a class depending upon the insertion of wedges between the cage and the guides. Another is that of M. Cousin, by which, if the rope breaks, a catch is caused to clutch another rope which passes over a pulley at the shaft top, and has a succession of heavy weights attached to the end and resting on seats. Thus, the spare or safety rope, by lifting one weight after the other, by degrees checks and counterbalances the cage and holds it suspended in the shaft.

The plan proposed by Köpe, in connection with the system of two cages with a balance rope passing from the bottom of one to the bottom of the other, is also one intended to act by arresting the descent of the cage gradually. In this arrangement a pair of side ropes connect the top of the two cages, and pass over special pulleys resting on spring pedestals, which are set on the pit-head frame; these pedestals, when the weight comes upon them, act as a brake. Although circumstances may sometimes favor the action of safety-clutches, it is evident that serious danger will still remain from the possible rupture of the guides, in consequence of the strain put upon them by the sudden checking of heavy weights (which may amount to 10 tons) when moving with velocities of 30 to 60 feet per second. In the earlier years of these inventions much confidence was placed in their certainty of action, but we have ourselves observed that several varieties, after being tried for a few years, have been discarded, whilst with regard to others which survive, opinions are much divided as to whether they do not introduce fresh sources of danger. There are, in fact, many cases on record of clutches coming into operation when not required. On the other hand, experience has unfortunately shown that many examples of safety appliances have, at the critical moment, failed to act, some even when provided with a brake lever under control of a practised man, in addition to an automatic arrangement.*

Such appliances will, of course, have the best chances of acting successfully with the ascending rope; and in cases where the speed is moderate, and the conductors are solidly made of wood or of iron or steel rails, we hope that some of them may yet be found available.

We have, however, examined several varieties of the safety cages in use, as well as those exhibited at successive International Exhibitions, and we have considered a large number recently described and figured in an elaborate paper by Herr Sulbach,† and we are unable to come to the conclusion that any one of them is a trustworthy safe-guard against accidents.

The destructive results arising from overwinding have been to some extent reduced by the introduction of "safety-hooks," which disengage the cage when it is raised too high, and leave it either attached to the guides by some of the means above referred to, or suspended to strong catches in the pit-head frame. Among those which operate in the latter way are the hooks employed since 1860 by Mr. Bryham, of the Rosebridge Colliery, and those patented respectively by Messrs. Ormerod, King, Walker, Ramsay, and Fisher. A great number of these hooks are now in use, and although it is urged by some that overwinds are thus made more frequent, we believe that no definite objection can be brought against the use of safety-hooks.

As further protection against overwinding we observe with satisfaction the addition to modern winding plant of a powerful steam brake, by which the engineman may bring his load to a stand within a few feet, and of an automatic arrangement to bring this brake into action in case of neglect by, or mishap occurring to, the man in attendance.

In the metalliferous mines, until successful working has been established on a considerable scale, it is usual to gain access to the workings by means of ladders. These, which elsewhere than in our southwestern counties were often very rude and badly fixed, have been much improved by some of the requirements of the Act of 1872. The number of accidents occurring to those travelling by this simple method is nevertheless such as to give, in Mr. Frecheville's district, a death rate of 0.189 per 1,000 persons employed, as calculated from 94,929 persons in the ten years from 183 to 1882.

The numerous other evils incidental to the ladder work in deep mines led to the introduction of the "man-engine" or *Fahr-kunst*, the reciprocating rods which admitted of men who ride by them ending their journey *ad libitum* at any required depth in the shaft, according to the position of their place of work. The two first examples of these contrivances erected in Cornwall were double-acting, and have, with the vicissitudes of the mines, ceased to exist. Those now working are all with the single rod, and the statistics for the same ten years are so far favorable that the death rate on 19,651 persons is only 0.152 per 1,000 persons travelling by that method.

This is a result far more satisfactory than that yielded by the statistics of the Prussian mines, in which it may be observed that most of the man-engines are double-rod machines. We consider that a due regard for the men's safety and health, as well as for the advantageous application of their labor, renders it desirable, so far as is reasonably practicable, to give them mechanical aid.

A few deep shafts have been shaped and fitted for hoisting the men by rope, but sufficient experience has not yet been acquired to show how far, with necessarily crooked shafts, and with numerous intermediate stations, a fair degree of safety can be insured.

It has been suggested to us that increased security would be obtained by requiring that all ropes used in raising or lowering men should be subjected to tests for strength and flexibility. From inquiries made on the subject it would appear that, for winding purposes, ropes of vegetable fibre have within the last forty years been almost entirely replaced in this country by those of wire, and that the leading makers of iron and steel rope are in the habit of carefully testing and registering the quality of the various kinds of wire of which they manufacture pit ropes.

It is important to remember that the strength of a rope, if tested for its whole length, may be seriously affected by too great a strain being put upon it in the process of testing, and hence that any step in this direction must be taken with great caution.

The danger caused by deterioration of wire ropes may in some measure be avoided by additional care in constantly inspecting them and seeing to their preservation from improper strain and from the corrosive effects of acidulous waters. It is also extremely desirable that the diameters of the coils and of all pulleys should be made as large as practicable, that every possible arrangement should be adopted to avoid sudden shocks or strains, and that, wherever it is feasible, springs should be introduced for the purpose of lessening the effect of sudden strains.

It appears to us that the breaking strain of ropes to be applied for winding purposes should not be less than from eight to ten times the weight of the normal load to be lifted.

XI.

Inundations.

Irruptions of water, which often threaten the safety of many persons at once, may be caused by one or th other of the following conditions:

By workings being inadvertently advanced too near to the bottom of the sea or some other body of water, or into soft or disturbed ground near the surface; or by accumulations of water, sometimes under great hydrostatic pressure, which have occupied the cavities of old workings.

In the first case provision ought to be made

* As at Botallack, in 1863, when the breakage of the chain in the inclined shaft caused the death of nine men, including the official who travelled with his hand on the brake lever.

† Zeitschrist für das B. H. and S. wesen XXVIII. 1 Heft. 1880.

in the leases by which the owner should prescribe to his lessee a certain minimum thickness of cover of solid rock, and certain dimensions of sectional area of excavations, matters wherein the co operation of the Mines Inspector of the district might, in doubtful questions, advantageously be invited.

The comparatively new regulations as to the keeping up and preservation of mine plans will doubtless in course of time tend greatly to decrease the liability to those accidents.

We are of opinion that, for meeting the danger of holding into old mines the general rule No. 9 in the Coal Mines Regulation Act provides sufficient safe guards, if the advanced bore-holes are only commenced with due promptness, and continued without intermission.

A similar provision ought *mutatis mutandis* to be inserted among the general rules in the in the Metalliferous Mines Act.

(TO BE CONTINUED.)

Recent Improvements in Dredging Machinery.*

BY A. WELLS ROBINSON, MONTREAL, CANADA.

It is the purpose of this paper to deal more particularly with the chain-bucket or elevator system of dredging, and to draw attention to its general character and capabilities as compared with other systems. This country possesses comparatively few examples of the chain-bucket machine, although the system is in general use in many of the most important harbor and river improvement works of the world, and on the Suez and Panama canals. The reason for this limited use may be found to some degree in prejudice, and in the fact that the single dipper grapple dredges so largely used have been made to do fairly good work in the hands of experienced specialists. The principal attention having thus been devoted to these machines, the knowledge of many regarding the chain-bucket machine is limited, or confined to older and what would now be considered inefficient examples, which cannot compete with the latest practice or be taken as representatives of it.

The number and importance of the dredging machines turned out by Great Britain, principally on the Clyde, and the fact that these are nearly all chain-bucket machines of the same general model, furnish a precedent which we cannot afford to disregard. A study of the best examples of these machines both in use and while building on the stocks on the Clyde, shows that while they contain some features which an American engineer would not care to imitate, they are, nevertheless, of the most solid and substantial character and excellently adapted to their purpose. With an iron hull, frequently self-propelling, and fitted with compound engines of marine type, which require massive gearing to transmit the power to the buckets, they exhibit a tendency to weight and complication that appears excessive, and are costly both to build and to maintain. Nevertheless their performance shows a very fair result in the total cost and quantity of work done. From published statements of the performance of the dredging fleet belonging to the Clyde trustees—who possess one of the most extensive plants for river and harbor work in the world—it appears that in the year 1882, five of their chain-bucket machines dredged an aggregate of 1,309,300 cubic yards of mud with some clay, blasted rock and boulders, at a total cost of $66,800 or 5.1 cents per cubic yard. Of this cost the wages, fuel and stores formed 44 per cent. and general repairs 56 per cent. These results may be taken as evidence that the chain-bucket, *as a system*, is good; the work of moving such a large volume of material at a low total cost being accomplished in a crowded river where interruptions are frequent, and in the face of a mechanical inefficiency which absorbed so large a proportion of the working expenses in costs of repairs; an inefficiency which appeared to be caused by mechanical difficulties and not inherent in the system.

In comparing the general principles of different systems of dredging, it will be seen that the strong point of the endless-chain machine lies in its continuous action, as distinguished from the intermittent action of the dipper or grapple dredge. The only other continuous discharge machines in use, to the writer's knowledge, are those constructed on the pumping or suction principle. The application of this principle is very limited and requires peculiar conditions to make it practicable, and a material which can be mixed with water to make a fluid capable of being pumped. In certain situations the discharge of the material with a large admixture of water is desirable or not objectionable, as where it is pumped on shore, to flow and distribute the solid matter over a considerable area. As a rule this is not the case, and for all ordinary conditions and for tough or stony digging, it seems to be the most rational method of excavation to handle the material bodily in a properly adapted bucket. The liability of the pumps, etc., to clog, and the friction and abrasion of the interior surfaces of the pumps and connections, are difficulties which have not yet been practically solved.

When the work is of sufficient extent, the chain-bucket machine can deal with large quantities of material at a rapid rate, and cuts a perfectly level bottom; which is difficult, if not impossible, to obtain with the single-bucket machines. The latter have also to dig considerably below the required depth in order to be sure that inequalities do not project above it; thus involving superfluous work. On the works with which the writer has been connected, it is customary to gauge the water level and depth of cut to inches, and to set the buckets to cut 6 inches below the depth to which the channel is afterwards tested. So accurately is this done with chain-bucket machines that vessels regularly pass with but a few inches between their keels and the bottom.

The digging action of the chain buckets takes place in a manner calculated to apply the power to the best advantage, the cutting edges entering horizontally and then curving upward on a short radius, so as to fill the buckets and retain the contents. They are also able to take off light cuts over large areas as efficiently as heavy cuts.

The entire apparatus is in equilibrium as to the weight of the working parts, power being required to elevate the dredged material only, and to overcome the digging and frictional resistances; whereas, in a dipper or grapple dredge the power expended in lifting the bucket and its attachments is lost at every stroke. This loss is quite considerable and in a deep-water machine is frequently equal to raising a weight of several tons to a height of 35 or 40 feet at each lift. In regard to the expenditure of power in a chain-bucket machine, it appears from indicator cards taken by the writer from the engines of several machines, that about 226,000 to 353,000 foot-pounds or 6 to 10¼ horse-power is required per cubic yard of material actually discharged when in effective work. Looking at a single-bucket dredge in a similar manner and working under similar circumstances, it is found to take 106 revolutions of an engine 14 × 16 with 75 to 90 pounds of boiler pressure, to deliver one bucketful of material of about 2¼ cubic yards. This at 90 pounds mean pressure in cylinder is equal to 1,305,920 foot-pounds or about 15.8 horse-power per cubic yard. These are actual examples, both working in tolerably yielding material, and in about 32 feet of water. Different cases will vary considerably: but the writer thinks that under ordinary circumstances, it may be assumed, that a dredge in which a single bucket is worked from a crane or boom, requires about double the power for the same work as a well-designed chain dredge.

It thus appears that the chain-bucket system is good in principle, and also good in practice, as its extensive use testifies, notwithstanding the mechanical difficulties to be overcome, in order to obtain simplicity and durability. These difficulties are not, however, confined to this class of machinery exclusively. Those experienced in the operation and maintenance of dredging machinery of whatever kind, do not need to be told of the almost incessant repairs made necessary by the severity of the duty, and by the wear and tear produced by conditions which are favorable to the rapid depreciation of the machinery.

Gradually, and by costly experience, are the weak points, eliminated and the efficiency increased, until a machine is produced which can be counted on with tolerable certainty, to do the work required of it. By such a process have the structural details of the endless-chain machine crystallized into something like a system, varied of course to suit different requirements.

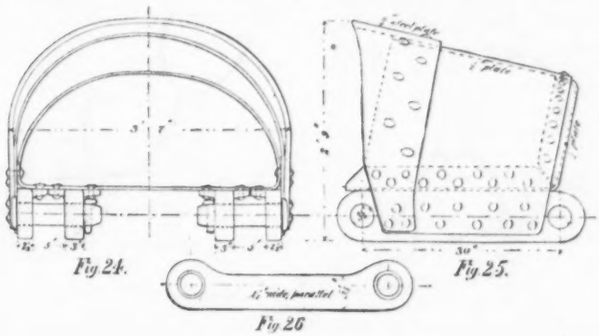


Fig 24. Fig 25.

Fig 26

In considering these details, the construction of the chain of bucket claims first attention. It is of obvious importance to keep the weight of these buckets at a minimum while retaining the required strength. With many forms of chain, the tension caused by its own weight constitutes so large a proportion of the total working stress, that only a small balance is available for doing the work. The degree to which strength and lightness can be combined depends first, on the tensile strength of the metal employed, and then upon a skillful distribution of that metal. In the earlier forms, many examples of which are still in use, the endless chain consists of a series of stout wrought-iron links connected by joint-pins, the shell or body of a bucket being riveted to every alternate set of links. There are usually four links under and forming part of a bucket, and two intermediate connecting links, the eyes of which are bushed with steel. Such a bucket and one of the links are shown in Figs. 24, 25 and 26, which are drawn from actual measurement, and may be taken as a fair example of an extensively used bucket. A chain of buckets constructed in this manner will do good and rapid work in moderately yielding material, while they can be kept at it; but the wear is excessive on account of the small and roughly fitted bearing surfaces of the joints, and the grinding action of sand and water. There being very little stiffness to this kind of bucket the springing of the plates and hard knocks tend to loosen the rivets, and about six months' work suffices to get the bucket ready for the repair shop.

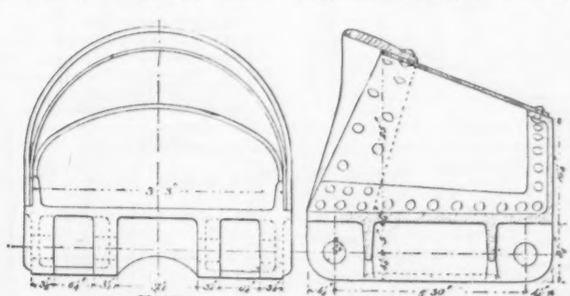


Fig 27. Fig 28.

Official returns of the performance of an extensive dredging plant in another locality, shows by a statement of repairs, the average life of a bucket of the kind described above to be 146 days, of a connecting

*Read at the New York meeting, Nov. 30th, of the Am. Soc. Mechanical Engineers.

link 77¾ days, and of a joint-pin 102 days, these being the average intervals of service before requiring removal for repairs. They will, of course, stand a limited number of such repairs before becoming finally useless.

With the recent development of the art of making sound and tough steel castings, new possibilities were opened up, and the four links of a bucket are now made in a connected form of a single steel casting, to which the top or body is riveted. A bucket of this kind is shown in Figs. 27 and 28. The construction is thus greatly simplified and much of the difficulty caused by the shaking loose of a number of riveted parts is obviated.

More recently still it has been shown that the entire bucket can be advantageously formed of a single steel casting. There still remained however, the destructive and costly wear of the bushes, pins and links used in connecting the buckets. Increasing the bearing surfaces and improving the standard of workmanship does not remedy the evil, as the amount of metal worn away with a sand and water lubricant, is nearly the same; but being distributed over a larger surface, takes a little longer time, and it did not seem to pay to put good work on joints which would not stay good.

In Figs. 30 to 33 is shown a bucket† of somewhat different design, but which follows out still further the direction indicated by the previous example. In this bucket the endeavor is made to combine the elements of lightness, strength, capacity and durability to a degree not heretofore reached. Durability of the pin connections is obtained by providing large wearing surfaces from which the sand and grit is excluded by a special form of self-expanding packing ring. These wearing surfaces are then lubricated by positive feed from a grease chamber formed in the bore of the tubular joint-pin, and which is arranged to be readily charged from the outside.

†Patented.

The bucket is composed of cast steel in one piece with renewable steel cutting edges and wearing surfaces, and so proportioned that the safe working strength is in excess of the maximum tension that can be applied so that the body of the bucket is practically indestructible.

It will be seen on reference to Fig. 29, in which several buckets embodying these features are shown in position upon the upper or driving tumbler, that they differ from all others both in general form and in the fact, that no intermediate links are employed to connect them, as they are coupled directly to each other. They are adapted to work on an improved driving tumbler in which the rear end of the bucket is supported by projections, forming an extension of the driving face of the tumbler. The links of the chain in passing over the tumbler as commonly made in the form of a simple polygon, were subjected to severe bending strains, caused by the eyes of the links overhanging the corner of the tumbler. The links thus required to be made of greater weight and strength than was necessary to withstand the mere tension. Considerable wear also occurred between the tumbler faces and the links; the corners of the former becoming rounded and increasing the liability to breakage of the chain. With the improved tumbler, having an extended seat on which the bucket bears for its whole width and length, the bending stresses are reduced so that the principal stress is reduced to a simple tension of the chain. The form of the bucket also permits of an enormous tensile strain being provided for without unduly increasing the weight; as the whole back, sides and bottom of the bucket, constitute a link of great strength, and excellent form to resist both tensile and bending stresses.

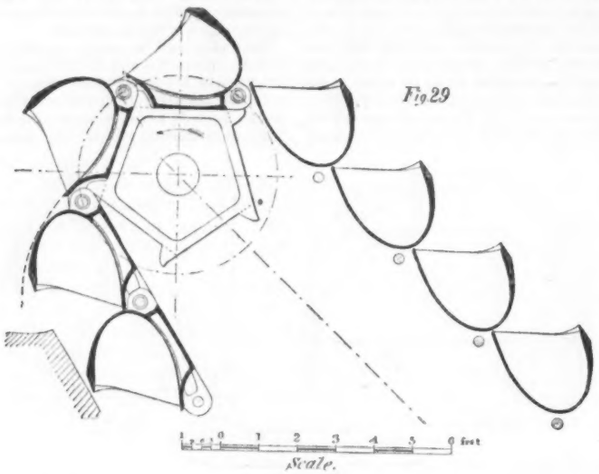


Fig 29

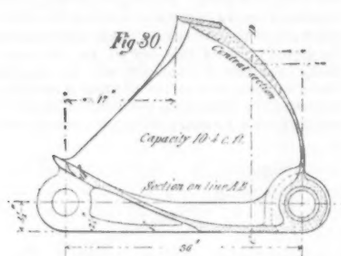


Fig 30.

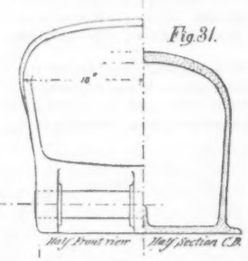
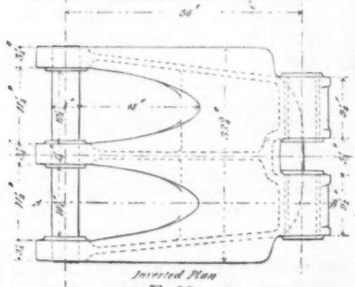
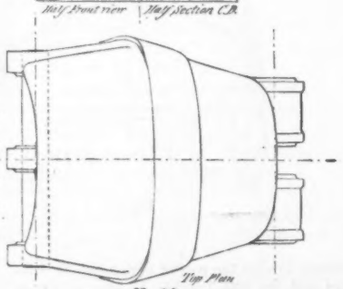


Fig 31.


Inverted Plan
Fig 32


Tip Plan
Fig 33.

It is of the highest importance to reduce the number of parts as far as possible. There are few mechanical appliances which are exposed to as rough treatment as dredge buckets, and it is conceived that the best way to prevent them shaking to pieces, is to make them with no pieces to shake.

The elevator system has always been an attractive one to inventors, and the Patent-office contains the record of many curious devices applied to dredging and excavating, some of which are modeled after a flour-mill elevator, and many employing a pitch chain composed of a multitude of small jointed links, with other devices equally unsuccessful in practical work. Many of these have never been heard of since, and some, which have been heard of, have by reason of the flimsiness of their construction, served to extend the popular notion that an elevator machine may possibly be made to dig sand or mud; but for stones and hard material is entirely impracticable.

The writer believes this to be a misapprehension of the capabilities of the system, as it has been successfully demonstrated that "hard pan," slate, shale or other schistose rock can be economically dredged from its natural bed with a properly adapted chain-bucket machine. In dredging of this nature, the principal work of the buckets is to break up the material, and for this purpose they are made of great strength and fitted with steel teeth of special form. The action thus resembles a series of powerful pickaxes delivering rapidly repeated blows. It will be seen that in work of this kind, a special advantage is derived from the doubling of the buckets, that is, constructing the chain wholly of buckets, instead of half the number connected by links, the digging effect being thus doubled.

Buckets for heavy dredging purposes, made entirely of cast steel, were first used in this country, to the writer's knowledge, about four years ago, upon the works with which he was connected. These have since been doing the severest kind of work, tearing up shale rock from its natural bed in 30 to 36 feet of water, and in a current of four to six miles per hour; and with the exception of some wear upon the renewable portions are practically as good to-day as at first.

There must inevitably be deterioration of the wearing surfaces of the buckets and connections, but while this is enormous with the older forms and appreciably reduced in the steel buckets referred to, by a judicious increase of bearing surface, it can only be minimized by keeping the abrading substance out of the joints, and supplying lubricant, as is done in the improved buckets shown in Figs. 30 to 33, designed by the writer.

For this purpose of comparing the three forms of bucket which have been illustrated, the following table of proportions and capacity is appended.

	No. 1.	No. 2	No. 3.
Maximum depth to which buckets can work, ft	30	31	30
Number of buckets in chain	40	34	46
Capacity of each bucket, cu. ft.	12	15	10·4
Pitch of each bucket, ins	30	30	39
Weight of bucket chain per foot run, lbs	480	623	440
Weight of bucket-chain per foot of capacity, lbs.	200	208	138
Total weight of chain tons	43	47	29
Safe work'g tension of chain, tons	47	50	45
Wearing surface of pin-joints square inches	31·5	42	75
Maximum pressure on pin-joints, lbs. per sq. inch	3,340	2,660	1,340
Ordinary speed of buckets, feet per min.	60	70	130
Discharging capacity, cub. feet per min.	144	200	416
Discharging capacity cub. yards per day of 10 hours	3,200	4,400	9,200

Nos. 1 and 2 being examples from British practice, it may be of interest to give some further particulars respecting the vessels and their performance.

The vessel referred to as No. 1 is 161 feet long, 29 feet beam, and 10 feet depth of hold; and is fitted with the wrought-iron buckets shown in Figs. 24 to 26. In one season of 2,694 working hours, this machine dredged 323,760 cubic yards at a cost of $9,987, or $3\frac{1}{10}$ cents per cubic yard.

The second vessel is 130 feet long, 32 feet beam, and 10 feet 6 inches depth of hold. In the first six months' work this machine dredged 409,500 cubic yards in 139 working days, at a cost of $9,309, or $2\frac{7}{10}$ cents per cubic yard. The material was mud and clay with some gravel and limestone marl, with a considerable number of snags and roots, and the cost includes wages, fuel, stores, repairs and maintenance, but not towing or depositing the material dredged.

It will be seen from the table that the weight of the bucket-chain in column No. 3 (as illustrated in Figs. 30 to 33), while of equal strength is considerably less per foot than No. 1 or No. 2. The increase of capacity and larger wearing surface should also be noted, together with the fact that a reduced pressure per square inch is obtained in protected and lubricated joint connections, instead of a heavy pressure in a joint exposed to the grinding action of sand and water.

With the improved buckets and simplified construction, the chain-bucket machine is capable of still higher results than those stated above, as much of the

difficulty labored under from excessive weight and wear and tear is done away with, and a machine produced which is cheaper in first cost, because the weight is less and cheaper to maintain, because more durable.

Fig. 34 shows a type of machine adapted for channel work, and represents a dredge having a capacity of 6,000 cubic yards per day, and capable of dredging to a depth of 25 feet. The mode of working is shown in Fig.

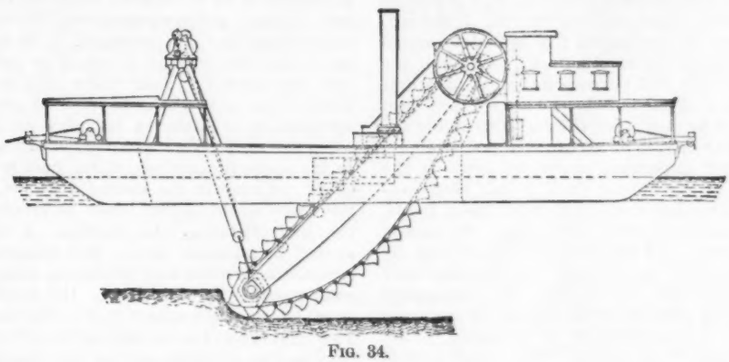


FIG. 34.

36. The hull is moored in position by anchor chains controlled by a steam winch, and the buckets feed sideways over the bottom for the width of the channel to be made, advancing a short distance ahead at every cut by hauling in on the bow-chain. In some cases a spud anchor-post is used at the stern for mooring the hull, the buckets at the front end taking a radial cut about

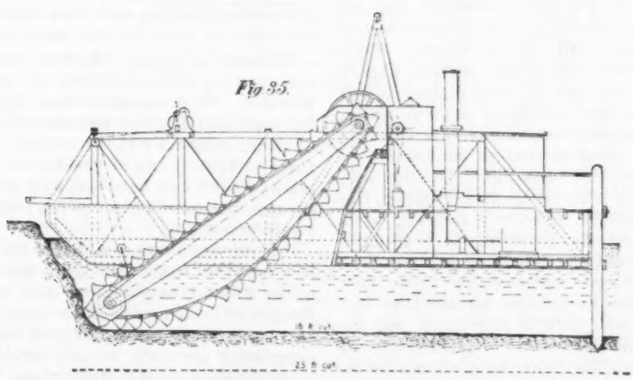


Fig. 35.

the spud as a center. A machine of this kind is represented in Fig. 35.

The range of application of the system extends to almost every kind of under-water excavation, and it is as well adapted for canal dredging as for channel dredging. A machine for the former class of work is arranged to cut in front, so as to excavate its own floating water, and to form the banks with the dredged material at one operation. In the case of a combination machine designed by the writer, the material is de-

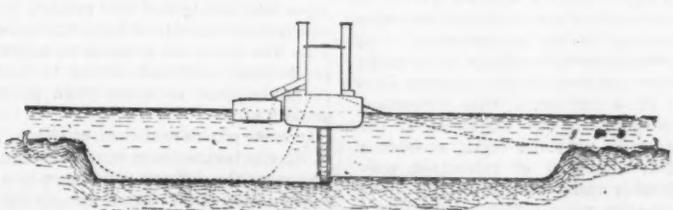


Fig. 36.

posited on the bank by a continuous discharging apparatus, which allows the excess of water to drain off before depositing, thus making a more solid embankment, and avoiding the washing back of the material into the cut.

In considering the cost of these machines, regard should be had not only to the first cost, but to the cost of maintenance in relation to the capacity, and to the extent and duration of the work to be done. One elevator machine, with a capacity of 6,000 cubic yards per day, will do better and cheaper work than four other dredges with a capacity of 1,500 cubic yards each, if employed on the same work, although the former may cost twice as much to build and run as one of the latter. Where the work is such that the machine can be kept employed without great or frequent periods of idleness, the first cost becomes a very small factor in the total cost of doing the work.

In many cases concentration of plant is desirable, as reducing the working and other expenses. This tendency is illustrated by the fact that a large proportion of British machines are now built as "Hopper dredgers," that is, a combined self-propelling dredge and scow, so that one vessel constitutes the complete plant. These vessels can dredge a load of 800 to 1,000 tons in a few hours, and then steam off at 8 or 9 miles per hour and dump it.

In conclusion, the writer has sought to present briefly the leading characteristics of the chain-bucket system of dredging and excavating, together with the defects and difficulties met with in making the system a success, both mechanically and commercially. He has also pointed out the direction in which improvements are being made in order to obviate these defects, and in making these improvements he has endeavored to increase the general efficiency, and to construct a chain of buckets that will be durable.

In view of the national and public works, in which dredging and excavating form a considerable part, it is of importance that the subject should be more fully understood, and the fact appreciated, that the cost of such work is largely governed by the efficiency of the plant employed.

The writer has not attempted to go into the many details, which go to make up a successful endless chain dredging machine; such as arrangement of hull, engines, and subsidiary gear, systems of framing, etc.; as they are capable of being adapted to a variety of conditions, and a description of which would exceed the limits of this paper.

Engineers' Surveying Instruments.—Their Construction and Use.

V.

(*Concluded from Page 307.*)

Written for ENGINEERING NEWS.

I. O. BAKER, C. E., PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF ILLINOIS.

THE LEVEL.

7. ADJUSTMENTS.—Nothing need be said of the ordinary adjustments; they are fully described in all text-books and manuals, but the following section, which is specially applicable to the dumpy level, is not so common but that it may be given here.

8. TWO PEG METHOD.—To adjust the dumpy level, proceed as follows: Drive two pegs into the ground, say 400 feet apart, set the instrument exactly half way between them, and carefully determine the difference of level in the ordinary way. A line joining the two positions of the target is a level line, and the difference between the readings is the true difference of level however much the instrument may be out of adjustment. Next set the instrument very near one of the pegs and redetermine the difference of level. If the second difference is the same as the first, the instrument is in adjustment. If the differences are not the same, raise or lower the line of sight, by manipulating the foot-screws, until the difference between the two readings is the same as the difference first obtained; the line of sight is then horizontal. Without altering the inclination of the line of sight, raise or lower one end of the level tube until the bubble is in the middle; the instrument is then in adjustment.

For example, let A and B, Fig. 9 (page 307 ante), be the two points. When the instrument is at c, midway between A and B, the targets are at a and b; ab is a level line. The true difference of level between A and $B = Aa - Ab$. When the instrument is at D, the targets are at c and d, and the apparent difference of level is $d\,e = (Cc - Bb) - (Ad - Aa)$. If the line of sight were horizontal the target would be at f; therefore df is the connection.

$$df = de\frac{A\,D}{A\,B} = de\left(\frac{2ac + B\,D}{2\,A\,c}\right)$$

If D is between a and B, the quantity $B\,D$ must be substracted.

The above is the only adjustmeut absolutely necessary with the dumpy level; but to save the trouble of leveling up every time the instrument is turned on its vertical axis, it is desirable to adjust the supports of the telescope so that the bubble will stand in the middle when the instrument is revolved on its vertical axis. This can be done by the method of adjusting plate levels.

9. SOURCES OF ERROR.—For convenience of discussion, will classify errors of leveling as follows:—1, Instrumental errors; 2, Rod Errors; and 3, Errors of Observation. In general a clear comprehension of all the sources of error, their amounts and the means of avoiding them, will be of great service in indicating the care necessary to secure a given degree of accuracy, and particularly in leveling is this true. In no other form of surveying, with the possible exception of chaining, it is as necessary to distinguish between cumulative and compensating errors, as in leveling. An apparently inappreciable cumulative error may in the course of a series of observations amount to more than a much larger, but compensating error. The effect of compensating errors is reduced nearly to zero simply by multiplying the number of observations, but cumulative error should be avoided entirely, or observations made by which they may be corrected. The observer

should avoid errors which usually occur in a single direction; but he need not always take the greater care to avoid errors which are as liable to be negative as positive. A clear comprehension of all the sources of error, their amounts, and the means of avoiding them, will be of great service in indicating the care necessary to secure a given degree of accuracy.

INSTRUMENTAL ERRORS.—The chief error of this class is lack of adjustment in the instrument; the one essential adjustment is that the line of sight should be parallel to the level. The ordinary method of adjusting the Y-level is too well known to be repeated here, but every Y-level should be tested by the two peg method as already described before being regarded as a Y-level; that is, a Y-level should be carefully adjusted in every particular and then tested by the two peg-method, and if this test shows it to be in adjustment then it may be regarded as a Y-level and ever afterwards adjusted as such, but if this test shows it not to be in adjustment the instrument is nothing more than a dumpy level and must be adjusted accordingly, and the telescope must not be reversed in the Y's. If a Y-level in adjustment by the ordinary method, is found to be out when tested by the two peg method, the error may be due to any one of several things; the rings may not be of the same size, the Y's may not have the same angle or may not squarely face each other, the optical center of the objective may not lie in the axis of the rings, the direction of motion of the objective may not be in the line of the axis of the rings. The relation of these elements is too complicated to be discussed here, but it is only proper to say that none of these defects are likely to occur to an extent appreciable in ordinary work for which the engineer should thank the accuracy of American machinery and the good workmanship of American mechanics, rather than the design of the instrument. All errors from any of the above sources are compensating and will be entirely eliminated by setting the instrument midway between the turning points.

There are a few minor instrumental errors, which though small in themselves and not occurring frequently may have an appreciable effect in very accurate work as has been demonstrated practically; they are (1) the setting of the instrument on its vertical axis, (2) the setting of the tripod legs into the ground in sandy ground or in ground which is thawing, and the heaving of the legs in spongy or clayey soil, (3) the sun heating and expanding one Y more than other. They are all cumulative errors.

ROD ERRORS.—The principal rod error is in not holding the rod vertical, and is greater for a large rod reading than for a small one; it is compensating, and may be eliminated by attaching a level to the rod or by waving the rod. With a good rodman this error should be inappreciable in ordinary work. With telescoping target-rods when extended, the slipping of the upper piece after the target has been pronounced correct and before the vernier has been read, is a source of error. The target itself may slip, but this is not so probable, because of its less weight.

Another source of error is the setting of the turning point, due in loose or sandy soil, to its own weight or to the impact of setting the rod upon it. The resulting error is accumulative. The remedy, in the first case, is to use a long peg, or rest the rod upon a triangular plate with the corners turned down slightly or with spikes on the underside. This foot plate with a convex button attached, on which to place the rod, is better for all cases than a peg. Whatever the turning point, the rod should never be dropped upon it.

Finally, another small rod error is the error in the graduated length. This affects only the total difference of elevation between the two points. This is a much more important source of error with the numerous home-made self reading rods now in use, than with the rods made by regular instrument-makers.

ERRORS OF OBSERVATION. The principal error is in reading the position of the bubble; an error may be made in reading it, or it may be read before it has stopped moving. If the sensitiveness of the bubble has been determined as described the levelman can easily find the error on the rod corresponding to a slight movement of the bubble; he knows then how carefully he must read the result to obtain the particular degree of accuracy aimed at.

Another important source of error is the moving of the bubble after it has been centered and before the sighting has been made. This movement of the bubble may be caused by its being read before it has come to rest, by disturbing the instrument by stepping near the tripod legs, by turning the instrument slightly in azimuth, or by raising or lowering one end of the telescope in focussing, or by the action of the sun or wind. The bubble should be re-read after the target is nearly adjusted, or, with a self reading rod, after the reading has been made and before the rodman is signaled to move on. These two probably constitute the chief sources or error in leveling operation.

In many Y levels there is no adequate means of keeping the horizontal hair horizontal and if it is not horizontal any observation not taken at the intersection of the cross-hairs will be erroneous. Since it is very tedious to bring the vertical hair to coincide with the rod at each sighting, and since the telescope is liable to get revolved in the Y's, it is almost certain that this error is frequently a great source of inaccuracy in leveling. It is compensating. To eliminate this error some instrument-makers fasten the telescope in the Y's, in such a manner as to prevent any rotation; others place a mark upon the collar of the telescope and another upon the Y, by noticing to see that these lines coincide, the leveler may be certain that the hairs are correct. This improvement can be added to any instrument by riveting a lug on the side of one of the clips and cutting a notch to match in the lip of the ring or collar on the barrel of the telescope. The work can be done in any machine shop. It is impossible to tell when the target is exactly behind the target or the point on the rod covered by the hair. Because a target rod is read to thousandths is no evidence that it is correct to that limit. This error is compensating, and varies with the form of target or kind of rod, distance and size of cross hairs.

With long sights there is another source of error, the curvature of the earth and the effect of the refraction of the atmosphere. The combined effect of these two items is to make the target when 225 feet distant appear one-thousandth of a foot high; this correction varies as the square of the distance. If the line of sight passes near the earth or over a body of water, the effect of refraction may vary considerably and consequently the above correction is only approximate. Ordinarily this error is compensating; and will usually be eliminated by setting the instrument midway between turning points.

Such blunders as an error of one foot or one-tenth in reading the rod, or recording the foresight in the back-sight column, or vice versa do sometimes occur; unfortunately they are not small, and in ordinary leveling there is no check against them which is practicable.

LIMITS OF PRECISION.—A great diversity of opinion exists as to what should be called accurate leveling, so diverse that nothing would be gained by citing them. Let us first consider the degree of precision attained in what is known as "precise leveling," by skillful observers, with the best instruments and plenty of time.

According to the theory of probabilities, the final error of a series of observations each of which is subject to error, and is liable to be greater as to be smaller than the true result will vary as the square root of the number of observations. For example, if in measuring a mile the error is 1 foot, it is probable that the error for four miles will be 2 feet. This is true, only when the error of each observation is as liable to be plus as minus, when the only errors are compensating ones. In the above illustration, if the chain were too short, the error in the second distance *due to this cause* would be four times as much as in the first distance. In leveling, a method should be adopted which will eliminate all cumulative errors; and therefore, since only compensating errors remain, the final error should vary as the square root of the distance. The final error due to cumulative errors will vary as the distance, and as it is highly improbable that all cumulative errors will be entirely eliminated, the final error will be a a little larger than proportional to the square root of the distance. The precision of leveling is usually assumed to vary as the square root of the distance.

It is pretty well established that the error of the most accurate leveling will be 0.005 feet $\sqrt{\text{distance in miles}}$, and even with the greatest care it may be as much as 0.020 feet $\sqrt{\text{distance in miles}}$. The first result may be taken as the extreme degree of accuracy attainable. To accomplish this, requires skillful observers, the best instruments, and plenty of time; ordinarily there are not more than three or four hours of the day on which this class of work can be done, and as a general average not more than one or two miles can be made per day.

It is impossible to establish a limit for work less accurate than the best, the conditions under which it may be done are too diverse. Results of leveling are often given of apparently greater accuracy than the above, but an occasional accurate result, probably more largely due to good fortune than good management, gives no indication as to what results may be regularly expected; naturally it is the most accurate result that is reported. However, the difference in precision between ordinarily leveling and precise leveling, is not as great proportionally as the difference in care, time, etc.; a little increase in accuracy cost a very great increase of effort.

A line of ordinary levels was run on the bank of the Mississippi river†, and checked upon the benches of the precise levels, with an average error of .011 feet $\sqrt{\text{distance in miles}}$. This was about the conditions under which a preliminary railroad survey is made, but is probably more accurate than such surveys usually are.

In some of the branches of the A. T. & S. F. R. R., the instructions were to re-run the line whenever the difference between the levels on construction and location was .03 feet between benches about 2,000 feet apart; this is equivalent to limiting the maximum admissable error to .048 feet $\sqrt{}$ distance in miles.

The amount of work that can be done by an observer in a day, is a point about which there has been much debate, and which will never be settled. Leveling is of different kinds, for different purposes, with instruments of different powers and delicacy, on different ground, and with varying atmos-

† Communicated privately to the writer.

pheric conditions. Professor J. B. Johnson, who has had large experience in levels of precision on the U. S. Lake Survey and on the Mississippi river, states, that "with a wye level and a target rod, a single instrument should duplicate 20 miles per mouth, with no greater error than 0.05 feet $\sqrt{}$distance in miles, or with a level of precision and speaking rod, do the same work with a limit of 0.02 feet $\sqrt{}$ distance in miles.

PRACTICAL HINTS. BEST LENGTH OF SIGHT.—The length of sight is limited by the power of the telescope and the atmospheric condition. It has just been seen that some errors increase directly and others indirectly as the number of sights taken in a given distance. In view of these facts, it is generally assumed that, for the most accurate work, the rod should be at least 100 feet and never more than 400 feet, from the instrument, for ordinary work, the best length of sight is thought to be 300 to 400 feet, while the greatest should never exceed 500 to 600 feet.

It is very desirable that at each setting of the instrument the length of the back-sight and the fore-sight should be equal; for, as has been seen, there are a number of errors which are proportional to the length of sight, but which cancel each other when the distances are equal. This is a very important point and should always be kept in mind. When stakes are set at regular intervals, there is no difficulty in determining the length of sights, and making them equal; in other cases, the distance can be easily determined by the principle of the stadia, as will be explained in the next chapter. All levels should be provided with two extra horizontal cross-hairs for this purpose.

In ascending or descending a hill, it is nearly impossible, and always very tedious, to make the back-sight and fore-sights equal. As the rod is about twice as high as the instrument, the down-hill sights will be about twice the length of the up-hill ones. When the ground renders sights of unequal length unavoidable, keep notes of the distance, and, as soon as possible, take sights with corresponding inequalities in the contrary direction. When approaching a long incline, make part of this compensation in advance.

RECIPROCAL LEVELING.—In crossing a river, it is absolutely necessary that the back-sight and fore-sight should differ considerably; also other somewhat similar cases occur, to which the principles of reciprocal leveling are applicable. The method of procedure is very simple.

Establish a bench upon both sides of the river and determine the difference of level; move the instrument to the other side, and redetermine the difference of level. If the sights were taken in quick succession, the mean of the two results is the true difference of level. Simultaneous observations with two instruments would be still better.

The surface of the water can not be assumed to be level, except there is no current, or the line joining the two benches is perpendicular to the current and there is no wind.

In ascending or descending a steep hill, it is desirable, for speed, that the line of sight should strike as near as possible to the bottom of the rod on the up-hill side, and to the top of the rod on the down-hill side. In selecting the position of the instrument corresponding to this condition, set the instrument up lightly, turn the telescope in the right direction, bring the bubble approximately to the middle by manipulating the tripod legs, and sight along the outside of the telescope. Even this rude observation will be valuable as showing whether the instrument should be moved up or down the hill. It will save considerable time.

With a little practice, the same observation may be made by drawing the tripod legs together and using them as a Jacob's staff; then the bubble can speedily be brought to its proper position by simply inclining the whole instrument.

If the up-hill rod is too near to be focused on, set a little to one side. In short intermediate sights for which the telescope cannot be focussed, it is sufficient to sight by the bottom of the Y's or by the side of the telescope.

If the line passes over a stream with steep high banks, or over a narrow, deep gorge or valley, establish a turning point on the farther side by reciprocal leveling; then, to find the depth of the opening, level down the bank without much regard to equality in length of sights or other refinements. This will usually be all that is necessary and is much quicker than leveling down one bank and up the other.

Instruments are often provided with sun shades to prevent the sun from troubling by shining into the telescope; if the metallic shade is not at hand, make one by rolling up a piece of paper and gumming, pinning or tieing it together, or springing a rubber band around it; it is easier and better than holding the hat or note-book over the objective.

If the instrument has once been leveled, and the bubble is found to have moved a little, bring it back with a slight pressure of the fingers.

Finally, in closing at noon or night, be careful to set halfway between the last two turning points; on resuming work, set near one of these points, and re determine their difference of level; the same difference of level each time, affords an excellent check upon the adjustments of the instrument.

Lucky French Railway Employes.

They pay only two cents per ton per mile for the transport of food and liquids intended for their own use on the roads employing them; hot drinks in winter and cooling drinks in summer are furnished at the company's expense; the railroads support supply stores furnishing employés with provisions, groceries, flour, wine and household utensils at merely nominal charges. In times of distress and dearness of living any employé whose pay does not exceed $360 per annum, in the neighborhood of Paris, or $300 in other sections, receives a monthly allowance over and above these sums according to the number in his family but not exceeding $3 per family. All classified employés, their wives and children supported by them are entitled, free of cost, to the advice and attendance of the company's doctor, medicine, surgical attendance and hospital treatment are included if the salary does not exceed $600 per annum. Free passes are granted to employés of every grade as a right; this privilege is equally accorded to the wives of employés, to the children for attending school, etc.; and more remarkable still, the father and mother, brothers and sisters, nephews, nieces, etc., of employés are entitled to half-fare tickets. Employés can also borrow money of the company without interest, to be repaid in installments monthly at the rate of one-tenth of their annual income. Praiseworthy acts of service are rewarded by gratuities, $155,000 having been so paid out in 1885. All of this is according to a descriptive paper of French railways in *The Railway News*, of London; and it would thus seem that the French railway companies occupy a very parental position in regard to their employés.

AN artificial stone of excellent quality and adapted to various constructive purposes is now made by mixing in certain proportions Portland cement, powdered granite, blast furnace slag, and water containing silicate of soda. The composition may be colored to suit the taste.

SELECTED MISCELLANY.

THE resurvey of Long Island Sound, commenced three or four years ago, has been completed. Present charts date to 1833-49; but it will be some time yet before the new charts are published with the changes and discoveries made since 1849.

THE word "California" first occurred in a novel entitled "Las Sergas de Esplandian," published in 1510. The name was first given to the present State, by Bernal Diaz, a lieutenant of Cortez, who wrote a memoir of his voyage "from Santa Cruz to California." So says Professor Davidson in a late lecture before the California Historical Society.

TOUCHING the weather forecasts and special warnings issued during the year, Gen. Hazen says in his late report that the progress made in indicating the approach of cold waves has been highly satisfactory, and he is convinced that property to the value of many millions of dollars has been saved through the agency of this service. The cold wave signal is now displayed by orders from the Central Office at 290 cities and towns in the United States, and from these points distributed by telephone and railways to about 20,000 stations. An appropriation of $5,000 is recommended for the extension of the service, and the opinion is expressed that no appropriation would be more acceptable to the people. Of the 1,065 cold wave signals displayed during the year 911, or 85.5 per cent., were justified.

AT the Ria Mines, Pyrenees Orientales, there is a very curious Lartigue railway, over which iron ore is carried for a distance of six and three-quarters miles. The line is worked by electricity, on a system designed by Messrs. Siemens, the full trains running down generating a current of electricity sufficiently powerful to haul the empty train up. The details of the system have not reached us, but we believe they consist in using the motor on the descending train as a dynamo, which generates sufficient current to work the motor on the ascending train, the difference between the weights of the two trains being enough to compensate for the loss of electric efficiency.

A SURVEY for the subway between Prince Edwards Island and the mainland has been completed, under orders from the Dominion Government, and it has been found that the sea bottom between Capes Traverse and Tormentine is solid clay, the very materia through which a tunnel can best be built. The nex question which arises is of a financial character.

JAPAN now reports two statues that would rival our "Liberty" in height, were they standing erect instead of sitting cross-legged, as they are. These are both figures of Buddha; the first, near the city of Nara, is in a temple 156 feet high, and the figure which is seated cross-legged measures 53 feet high from the top of the low pedestal to the crown of the head. It is made of plates of bronze 6 to 10 inches thick soldered together. The face is 16 feet long by 9½ feet broad, and the width across the shoulders is 29 feet. The second statue is the Great Buddha at Kamakura, fifteen miles from Yokohoma. This is seated as the other and 49 feet 7 inches high.

TALLAHASSEE, County, Fla., boasts of a man who has lived on one farm and in one house to be sixty years of age, and yet has changed his State residence no less than four times. The incident is explained by the fact that no two out of the four State line surveys have been the same, and he has alternated therefore between Georgia and Florida. Just now he is a Floridian, a recent survey having run the line north of his house.—Philadelphia *Press*.

A USEFUL discovery is announced whereby the faded ink on old parchments may be so restored as to render the writing perfectly legible. The process consists in moistening the paper with water and passing over the lines of writing a brush, which has been wet in a solution of sulphide of ammonia. The writing will immediately appear quite dark in color, and this color, in the case of parchment, it will preserve. On paper, however, the color gradually fades again, though it may be restored at pleasure by the application of the sulphide. The explanation of the chemical action of this substance is very simple; the iron which enters into the composition of the ink is transformed by reaction into the black sulphide.

BY a new process of toughening wood, it is claimed that the effect produced upon whitewood is such that a cold chisel is required in order to split it—this result being accomplished by a special method of steaming the timber and submitting it to end pressure. By this means the cells and fibers are compressed into one compact mass, and some of the timber commonly considered unfit for use in such work as carriage building, for example, can be made valuable by this means as a substitute for ash, hickory, etc. This method is applicable, of course, only to wood in comparatively small quantities or sizes.

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MAGAZINE RENEWALS.

The *Century Magazine* closes its yearly volume with the *October Number*. Renewals are in order for November. The price to ENGINEERING NEWS subscribers and their friends is $3.55; with ENGINEERING NEWS, $3.55. The new *Scribner's Magazine* will be out December 1. Price $2.50 to our subscribers. *Harper's Monthly* is renewable on December 1. Orders ought to be sent in in November to save the publishers trouble.

TABLE OF CONTENTS.

	PAGE
Accidents in Mines	353
Recent Improvement in Dredging Machinery (*Illustrated*)	355
Engineers Surveying Instruments, Etc.	367
Lucky French Employés	359
Selected Miscellany	359
Editorial Notes	360
Civil Engineering Education	360
The Trade and Commerce of Canada	360
The Jetties and the Late Gulf Storm	361
Natural Gas and the Pipe Used in its Service	361
Irrigation	361
Friction of Non-Condensing Steam Engines	362
American Society of Civil Engineers	362
The New York Electric Subway	363
North Carolina	363
Personal	363
Engineers Club of Philadelphia	363
St. Louis Engineers' Club	364
Seventh Annual Convention of the American Soci- of Mechanical Engineers	364
Western Architects	366
Correspondence	366
Combined Reed and Plaster as a Building Material	366
Water	367
News of the Week	367
Market Report	368
Market Summary	368
Building Items	368

THE New England Water-Works Association will hold its next regular meeting at the Quincy House, Boston, Mass., at 11 A. M., December 8th, for business, and the discussions of such topics as are presented.

WE would again remark to our contemporaries, American and foreign, that a little more attention paid to the use of our proper journalistic title would be gratifying. We will admit that our full name is rather lengthy; but, if it is thought best to save some space by abbreviating it, we pray you, refer to us as ENGINEERING NEWS, rather than by the latter part of our title only.

While on this subject, we might as well have a word with those who use our matter without giving any credit. Within the week two prominent New York journals have appropriated matter prepared by us at a considerable outlay of labor and expense. One of these says nothing concerning the sources of its information, the other refers to us as ENGINEERING, thus applying to us the name of a very worthy English contemporary. We will mention no names at present, but simply request a little more journalistic courtesy.

MR. J. S. JEANS, in his late paper on the "Cost and the Conditions of Working Railway Traffic in Different Countries," read before the Statistical Society of London, shows symptoms of becoming a convert to American railway theory and practice.

He first states that he sees no insuperable reason why British railways should cost four times as much as American roads when the natural obstacles to be overcome are the same and labor and material about equal in the two countries. As to the comparative character of construction in England and America he further says that there is a happy medium between flimsy and unnecessarily substantial construction which Englishmen would do well to follow.

Mr. Jeans charges the present exhorbitant railway rates, that are now causing trouble in England, to the excessive cost of railway administration there and to bad management in granting preferential rates to the goods of foreign manufacturing rivals and loading down home traffic with enormous carriage and terminal charges. In his recommendation of much lower rates and the increased traffic to accrue he again refers to American experience and illustrates the bad effects of the present English management by numerous individual cases.

Civil Engineering Education.

With the first issue of the coming year we will commence the publication of an exhaustive paper upon the above named subject, to be followed by discussions of the same by prominent engineers, and teachers of engineering in the United States.

The proper education of engineers, while it is really of vital importance to our future scientific and technical progress, has as yet never been systematically or properly treated; and while it has been very generally admitted that the methods of instruction in our technical schools generally, have not kept pace with the advance in knowledge and practice, little, if anything, has been published regarding the actual detail of proposed improvement.

The initial paper proposes to point out the causes of present trouble, and suggest a remedy therefor, and is written by Mr. J. A. L. Waddell, M. Am. Soc. C. E., late Professor of Civil Engineering in the University of Tokio, Japan, the author of works on bridge construction, etc., and now actively engaged in the practice of engineering. He can thus speak from the standpoint of both the engineer at work and the teacher of engineering. Prof. Waddell handles his subject exhaustively, and gives the full detail of his proposed reforms, as can only be done by one very familiar with the matter to be treated.

But as Mr. Waddell himself says, to do this subject full justice it must be discussed by both engineers and professors of engineering; and the professional standing and general repute of the gentlemen who will enter into the discussion of Prof. Waddell's proposed improvement is a sufficient warrant in itself for the value of this paper and the interest it has awakened. Among the civil engineers who will express their opinions are Messrs. A. P. Boller, W. H. Booth, G. Bouscaren and Thomas M. Cleeman. Among the teachers of engineering who will discuss the paper are Prof. William H. Burr; Prof. A. J. Du Bois, of the Lawrence Scientific School, New Haven; Prof. Robert Fletcher, of Dartmouth College; Prof. R. A. Hardaway, University of Alabama; Prof. J. B. Johnson, of Washington University; Prof. P. H. Philbrick, of the Iowa State University; Prof. Geo. F. Swain, Mass. Inst. of Technology; Prof. D. C. Humphreys, Washington & Lee University; Prof. W. G. Raymond, University of California; and Prof. F. N. Wilson, of Princeton College.

Other engineers and teachers have signified their intention of taking part in this discussion as it progresses; and as the purpose is to obtain the views of all interested in this subject, the invitation is extended to such of our readers whose experience would lead them to suggest points of improvement in present methods. We would especially desire the opinions of civil engineers in extended practice; they, with very few exceptions, are graduates of either American or foreign schools, and are in a position to decide between the merits of the theory of engineering as taught, and the actual practice of engineering.

The Trade and Commerce of Canada.

The Secretary of the Montreal Board of Trade and of the Montreal Corn Exchange Association has compiled and issued a report on the Trade and Commerce of Canada for the years 1883-84 and 85, which both in the tables and in the text shows a very comfortable state of affairs for our neighbor in the North as well as for ourselves.

The exports of merchandise have grown from an average of $57,000,000 for the three years ending 1872 to nearly $84,000,000 for the three years ending 1884, a gain of nearly 32 per cent.; considering that the first three years were during a "boom" and the last three years during a season of depression the results are satisfactory. In manufactured articles the gain is over 35 per cent. It would be interesting to know where these manufactured articles are sold. Great Britain and Ireland take about 27 per cent. of our manufactures and Germany nearly 8 per cent. Canada sold her last ship to other countries in 1875. The average exportation of $83,820,116 was distributed as follows; Products of Agriculture, 27 per cent. Animals and their products, 25 per cent. Fisheries, 10 per cent. Forests, 30 per cent. Mines and Manufactures, 4 per cent. each.

The percentage of trade was as below for the years given

CANADIAN IMPORTS.

	Great Britain	United States	Other Countries.
1873	53.74	37.44	8.82
1885	40.31	45.91	13.87

AGGREGATE TRADE.

1873	49.36	41.32	9.32
1885	43.39	45.28	11.33

The greatest change has been in sugar. In 1878, only 7 per cent. of their sugar came from sugar-producing countries; in 1885, over 95 per cent. came from sugar-producing countries, or in other words we with Great Britain were refining over 101 million pounds of sugar for Canada on the first date out of a total importation of about 109 millions while now the two countries do not refine 10 million pounds for that market out of an importation of 200 million. "Since the initiation of the present fiscal policy of the Dominion, a large amount (not less than $2,500,000) is paid out annually to Canadians for refining, barrelling and shipping the sugar,

which was formerly distributed among the people of Great Britain and the United States."

It is noted that the "End of Track" post office on the Canadian Pacific R. R., issued postal orders to the amount of $65,304 during ten months of its existence. Canada has 7,084 post offices and 50,461 miles of mail routes with 10,150 miles of railroad, and a train mileage of over 50½ million miles. "The estimated number of persons dependent on the Grand Trunk Railway for employment, as well as subsistence (is) about 65,000." The length of the road, as given by Poor, is 2,912 miles, this gives over twenty-two persons supported for each mile. A usual estimate is, that five persons are employed for each mile of railroad in this country, we have never before seen an estimate of the number supported.

Under the head of the St. Lawrence river and the canals, it is asserted that the dredging of the 27½-foot channel between Montreal and Quebec will be completed by the close of 1887, and during the last twenty years the proportion of steam tonnage to total at the port of Montreal has increased from 43.8 per cent. to 90.61. Heading the tables comparing the grain trade of Montreal with that of five ports in the United States, is the statement that while tolls were charged on both the Erie and St. Lawrence canals, the proportional volume of yearly traffic carried on each did not greatly vary, but when the Erie canal was made free the St. Lawrence route collecting tolls, the share of the latter was greatly reduced. But during the present year, 1886, the tolls have been abated with the eminently satisfactory result that, during the first three months of the year the receipts of grain by canal, were nearly equal to those of the entire preceding year.

The Jetties and the Late Gulf Storm

The cavillers against the jetty system, as used at the mouth of the Mississippi and at the Sabine Pass, should be pretty well convinced of their stability, at least, since the late devastating storm in the Gulf. The objectors to Mr. Ead's plans have foretold all manner of evil as likely to result from the occurrence of a typical Gulf hurricane; and now an exceptional storm of this character has passed over them, and they remain intact.

Major Heuer, U. S. Engineers, has carefully examined the work at the Mississippi, and especially upon the unfinished work, of like character, at Sabine Pass; no harm at all was done at the first named point, and the examining officer "found the Sabine jetties entirely uninjured, and no material change in the depth of the channel between them. They had withstood the fury of a storm that had swept away every human structure on the adjacent land." This is a very good record for the "frail willow mattresses."

Natural Gas and the Pipe Used in its Service.

According to a late issue of the *American Manufacturer*, there are at present six companies piping gas to Pittsburg, Pa.; the names of these companies and the number and localities of the wells controlled by them, are given as follows:

Company.	Murrysville.	Tarentum.	Hickory.	Canonsburg.	T'l.
Philadelphia	48	10	—	—	58
Chartiers	7	—	16	—	23
Manufacturers	—	—	—	10	10
Pennsylvania	—	1	—	7	8
Washington	—	—	5	—	5
People's	3	—	—	—	3

The total mileage of pipe for supplying Pittsburg exceeds 500 miles of various sizes, 232.4 miles being within the city limits. The total combined area of this pipe at the wells is 1,346,608 square inches, and the area at the city line is 2,337,083 square inches.

In the city of Pittsburg each company has the following amount of pipe: The Philadelphia Co. has a total of 971,203 feet, ranging in size from 30 inches to 3 inches; 8 inches and 6 inches predominating; the Chartiers Co. has 116,976 feet, from 20 inches to 6 inches; the Peoples' Co. has 67,280 feet, from 8 inches to 4 inches; the Pennsylvania Co. has 34,575 feet, from 16 inches to 3 inches; the Manufacturers' Co. has 26,530 feet, from 12 inches to 8 inches, and the Washington Co. owns 10,300 feet of 6 and 8-inch pipe. The aggregate amount of all this pipe is 1,226,864 lineal feet; the various sizes used being shown in the following table:

Total Number of Feet of Natural Gas Pipe of Each Size Laid in the City of Pittsburg.

Size of Pipe—Inches.	Feet of Pipe Laid.	Size of Pipe—Inches.	Feet of Pipe Laid.
30	11,589	8	379,710
24	66,899	6	268,295
20	76,362	5¾	152,989
16	26,756	4¾	4,091
12	43,091	4	138,854
10	18,613	3	10,615

In the distribution of natural gas in Pittsburg, the lines of the Philadelphia Co., the largest supplier of gas, may be taken as an example. Here a 30-inch main forms the backbone of the city system, decreasing by a 20-inch and a 16-inch pipe; from which low pressure laterals are run to furnish the domestic supply. On this system are twenty-one stations from which the pressure on all connecting lines can be controlled by valves, which are regulated hourly, day and night, to meet the varying demands.

To avoid leakage and consequent danger to life and property, the pressure in the city mains is kept down to a maximum of 13 pounds, which is diminished in the larger lines to from 6 to 8 pounds per square inch. To this end also mills and houses are supplied through regulators which maintain any fixed pressure and automatically close if the supply is cut off. The pressure of the gas at the wells, when shut in, is given as about 500 pounds to the square inch; in new wells it much exceeds this for a few weeks, but in a comparatively short time falls to about the normal pressure which is an average for all wells in the same gas field. This average pressure differs, however, in different natural gas districts.

The Philadelphia Co. alone supplies 470 industrial establishments with fuel, and in addition about 5,000 dwellings within the city limits; it has a capital of about $7,500,000 invested in this enterprise.

The comparative merits of cast and wrought-iron pipe, in the carriage of gas, having been made the subject of a query by readers of ENGINEERING NEWS, we applied to Mr. Charles Paine, Vice President and General Manager of the Philadelphia Company, for some information on this interesting subject. Mr. Paine very courteously sends us the following, which we publish in full, as data gathered from a wide experience:

The comparative merit of wrought-iron and cast-iron pipes in the carriage of natural and artificial gas, which you inquire about, is chiefly one of dimensions.

The screwed joint properly protected, is undoubtedly the best joint for use with gas pipes; and up to 8 inches in diameter, we use wrought-iron pipes exclusively, although some use cast-iron for the distribution of gas under low pressure, down to 4 inches in diameter. Above 8 inches the screwed joint has not been made satisfactory. The wrought-iron pipe is so much stronger than cast-iron that we prefer it with a leaded joint for all sizes up to 16 inches; using a cast-iron sleeve joint with wrought-iron bands shrunk upon the sleeve. With all wrought-iron pipe, there should be occasional sleeve joints, leaded, to serve as expansion joints, preventing the great strain which would otherwise come upon the threads of the screwed joints.

The wrought-iron pipe is not so easily protected against decay as the cast-iron, and is more likely to be corroded in the bad soils of a city; therefore we use cast-iron entirely for the mains of from 20 to 30 inches in diameter. These pipes are made with a double-bowl at each joint, the outer bowl containing a cavity for the reception of any gas which may leak from the lead-joint of the inner bowl; the outer bowl being closed with a preparation of asphaltum. From the cavity an escape-pipe leads to a lamp post in the sidewalk, or to some other place, where the gas may be safely discharged.

It had been understood at the outset, by Mr. Westinghouse, (President of the Philadelphia Company), that the joints of gas pipes, whether of wrought-iron or cast-iron, whether screwed or leaded, could not be maintained in so perfect a condition that they would not leak; accordingly, he devised methods whereby the inevitable escape of the gas from the joints is provided for; the gas being received into suitable chambers surrounding the joints, and conveyed away by escape-pipes to a place where it may be safely allowed to enter the atmosphere. Although the gas escaping from the first joint is thus provided for, there is still an opportunity for some gas to escape at low pressure through the more or less imperfect joints formed by the casing which surrounds the first pipe joint and from imperfections in the casings. This low pressure leakage is provided for by surrounding the casing with broken stone, covered with a sheet of heavy tarred paper. From the summit of the heap of stone, an escape pipe is carried away to the lamp-post or other safe place of discharge; in this way the escaping gas is prevented from intrusion into the soil and thence into adjacent cellars and vaults, where it would become a source of great danger, because of its liability to explode, should it be ignited by accident or design; and this it is very likely to do when the surface is closed by frost or by compact clay, unless an open passage is provided for it to a place of safe discharge.

Irrigation.

Mr. Edward Bates Dorsey, Member of the American Society of Civil Engineers, read before the Society on November 17, a carefully prepared paper upon the subject of irrigation as applied in various countries, and outlined the benefits to arise from its use, in the arid sections of the United States.

After referring to the labor and money expended upon irrigation in Italy and India—the English government having expended up to 1881, $86,000,000 on irrigation works in the latter country—the author remarked that more than one-third of the total area of the United States, or 1,387,000 square miles, could not be farmed without irrigation. Whether mountain ranges and lakes and rivers were excluded from this estimate was not stated.

The duty of water, is of course very variable in different localities depending upon the soil, climate, crops, etc., and last but not least upon the intelligence of the irrigator. Mr. Dorsey gives a table of this duty as obtained from the most reliable sources, showing with the average rainfall the inches of water actually applied per annum to a varying number of acres, together with the crops grown on the land irrigated. This duty is computed upon the basis of the number of acres irrigated by one cubic foot of water per second.

A commission appointed by act of Congress in 1873, and consisting of Gen. B. S. Alexander, Col. George H. Mendall, United States Engineers, and Mr. George Davidson, United States Coast Survey, after a thorough investigation of the subject fixed upon a duty of 200 acres per cubic foot of water as adapted to Central California with an annual rainfall of about 10 inches. In India one cubic foot of water per second irrigated, of wheat, maize, etc., in Upper India 267 acres, on the East Jumna canal 306 acres and on the Ganges, 232 acres. This means an average depth of 32, 28 and 37 inches, exclusive of rainfall.

The author then refers to the importance of

irrigation even in the Eastern portion of the United States with a rainfall of from 30 to 48 inches; and the increased duty which could be secured by the proper distribution of the total rainfall in all cases when possible.

Mr. E. S. Nettleton, State Engineer of Colorado, gives the "run-off" of the Cache la Poudre river, with 972 square miles of watershed, as equal to 48,523 cubic feet per acre annually, or about 13.367 inches, with a mean annual rainfall of 33.6 inches. In May, June and July 22.55, 40.97 and 18.74 per cent. of the annual discharge passed away; or in other words in the three months in which the crops are growing 82 per cent. of the annual total volume flows down stream.

This means that reservoirs are a necessity in any irrigation scheme to hold back a reserve for the demand for water after June. The cost of storage reservoirs depends upon the locality and geological and topographical conditions. Mr. Allan Campbell estimated $200 as the average cost of each million gallons stored in the Croton valley; the proposed Quaker Bridge Dam would reduce this average to $125 for a like quantity; the late surveys and estimates on the proposed extension of the Philadelphia water works would make the average in eleven reservoirs $131.84 per million gallons stored; while a recent survey in Idaho, in exceptional favorable locations, made the average cost in five reservoirs $2.05 per million gallons. In Spain, the average in six reservoirs was estimated at $54.17 per million gallons stored. At the rate of 180 acres irrigated 16 inches deep by one cubic foot of water per second, each acre would require about 500,000 gallons for the crop season of four months.

Mr. Dorsey then enters into the cost of irrigating works, and shows that in California and Colorado, the cost is from $7.30 to $53.33 per acre irrigated; in France, it is $35.67 to $81.25, in Spain, $46.66, and in India $6 to $14 per acre irrigated. The present Colorado system includes 800 miles of main canals completed, and 150 miles projected; the secondary canals are about 3,500 miles in aggregate length. The cost of the entire system has been from $10,000,000 to $12,000,000, and the land open to irrigation is about 2,200,000 acres; average cost per acre is thus $5.00.

In regard to evaporation and seepage from irrigation canals, the author notes the first as forming but a small portion of the loss, and quotes Mr. Walter H. Graves as making this loss during the irrigating months in Colorado as equivalent to .09 to .16 of an inch per day. Mr. Graves thinks that a deduction of 12 per cent. from the carrying capacity of old canals, will allow for both evaporation and seepage. As the seepage will depend on the soil and care with which the canal is constructed the author gives 20 per cent. as a liberal allowance, under ordinary circumstances, for the loss from both causes, and that will be reduced as the banks and bottom become compact by silting, etc.

Mr. Dorsey gives full statistics as to the increased yield of irrigated land, and quotes from the report of Mr. A. D. Foote on the desert lands near Boise City, Idaho. The profits are variable, depending on crops, soil, climate and market, but the comparative profit as between irrigated and unwatered land is made very apparent as in favor of the former. As examples, California lands purchasable at $3 to $10 per acre, becomes worth $50 to $200 per acre, when water for irrigation is brought to them. Statistics of Spanish properties prove this still further, the difference in prices in various localities ranging from $80 to $900, $60 to $360, $50 to $700, etc., as between the same lands unwatered and watered.

The question of riparian rights and the ownership of water is a very important one in the western states and territories of the United States. In California, it had been a custom from the earliest settlement for mining ditches to hold absolutely all the water actually appropriated and diverted for use, and the same custom was followed with regard to irrigation channels. But, as the old English law is still in force in that State, a late decision of the highest court of appeal has decided in favor of the riparian owners and thus reversed at one blow the practice of forty years. The same law and ruling would hold good in Nevada; but in Colorado, and the territories of Montana, Idaho, Dakota, Wyoming, and New Mexico, Arizona and Utah legislation has wholly abandoned and abrogated the common law in this connection, and has in all streams and lakes, public and private, abolished private property therein, unless the owner has made an actual appropriation and diversion of the flow. In other words, the water belongs to the man who first uses it for land, etc., regardless of unappropriated ownership further down the stream, and this first appropriator can direct a part, or even the entire stream into his irrigation canals. This seemingly arbitrary law, so contrary to long established rights elsewhere, is enacted in accordance with sections 2,339 and 2,343 of the Revised Statutes of the United States, which gives to the sections named the authority to enact such laws regarding water for irrigation, and other useful purposes as they may deem best for their interest.

This reference to the fact that, in the States named, a proprietor derives no legal advantage from simply owning land adjacent to a stream, brought about a lively discussion by the members of the Society; and Mr. Dorsey had to acknowledge that, while it was the law in those sections, it was likely to lead to much future litigation and trouble.

Friction of Non-Condensing Steam Engines.

At the Annual Convention of the American Society of Mechanical Engineers, held in this city this week, Prof. R. H. Thurston read a paper on the above subject, detailing certain experiments which definitely proved the incorrectness of the hitherto quite generally accepted assumption of De Pambour, viz. that the wasteful resistance of a steam engine consists of a constant quantity, the friction of the unloaded engine, increased by some increasing function of the added load.

Prof. Thurston's experiments were simply accurate measurements of the indicated, and of the actual (brake) horse-power of non-condensing engines running under certain prescibed conditions. In one set of experiments, in which the steam engine was running at the same rate of revolution, but according to a varying brake-load was developing different horse-powers, it was found that the difference between the indicated and the brake horse-power, which measures the friction of the engine, was practically the same, with loads varying in their horse-power, demands from 7.41 to 57.54 horse-power.

Prof. Thurston also experimented with the non-condensing engine running at different speeds.

The following conclusion summarize the results of Prof. Thurston's investigation in this direction to date, but it should be borne in mind, they are only put forth as relating to non-condensing steam engines of the horizontal stationary type:—

1. The friction of the non-condensing engine, of horizontal stationary type is sensibly constant at any given speed, at all loads, and is at different speeds entirely independent of the magnitude of the load.

2. The friction of non-condensing engines, of the horizontal stationary type, is variable with variation of speed of engine, increasing as speed increases, in some ratio as yet undetermined, but probably different with every engine and, for the same engine, with every change of condition of operation.

3. The friction of non-condensing engines, of the horizontal stationary type increases with increase of steam pressure, in a probable similarly variable manner with that observed with alteration of speed, neither method of variation being capable of representation by any convenient algebraic expression.

4. The total resistance measured at the piston of the engine is composed of two parts, the one sensibly constant at the working speed, the other variable with external load, and may be, for practical purposes at least, represented by the expression,

$$R = R_1 - R_0,$$

in which R is the total resistance, as shown on the indicator diagram, R_1 the resistance due to external load, *i. e.* as measured by a Prony Brake, and R_0 the resistance of the unloaded engine, as shown by a "friction-card" taken with the steam engine indicator.

It is but fair to say the conclusions reached by Prof. Thurston by experiments, have been held in a general way by many steam engineers, who have long ago practically discarded the value of De Pambour's assumption. But Prof. Thurston deserves no less credit on that account for his experimental evidence to crystallize the correct theory.

American Society of Civil Engineers.

At the regular meeting on Wednesday evening last, Vice President Thos. F. Rowland presided, and about seventy-five members and visitors were present.

Mr. F. Collingwood presented the report of the committee on *The Compressive Strength of Cements, and the Compression of Cements and the Settlement of Masonry*, which we will note in another issue. Mr. Henry Faija's paper describing his method of *Testing Portland Cement* by the aid of steam and warm water was read and Mr. Alfred Noble then followed with a paper on *The Effect of Freezing on Cement Mortar*, as gathered from his experience on the Northern Pacific Railroad.

This last paper lead to an extended discussion on the value of salt or brine used in this connection. The general opinion seemed to be that salt was safer and cheaper than any method of warming the sand or water; the brine should be strong, and its only value was in keeping the mortar plastic while being laid. The opinion was also general that there was no ultimate injury to cements from freezing, but that the setting was retarded as long as the mortar was frozen. The use of clean sea-water in mixing cement mortars, either Portland or American, had no injurious effect upon the setting qualities of the mortar, according to the experience of members present; sea-water contaminated with sewage, as found about the docks of New York, was objectional.

Mr. Edward P. North exhibited several types of paper and metal tubes, with various coatings, as proposed for use in the electrical subways of New York, and also sections of proposed continuous conduits. Mr. North described the difficulties met with in forming the tubes or ducts in these conduits and the manner in which these troubles had finally been overcome.

The most interesting of these exhibits were the tubes and pails made of "indurated fibre." This is simply wood pulp made from spruce

timber, it is moulded in any desired shape and then subjected to a hydraulic pressure of 120 pounds to the square inch. The product is then dipped successively into a hot mixture of boiled linseed oil and resin, and between each dipping baked with increasing heats up to about 300° F. As made into pails, the result is a very strong, highly-glazed article, impervious to almost all liquids and practically indestructible. Mr. Medbury, the manufacturer, was present and described the mode of manufacture. Some difference of opinion arose between Mr. North and himself as to whether he was or was not attempting to make barrels of this product which could be used for transporting petroleum to France and sending back wine in the same barrel. Many uses were suggested for this indurated fibre, as in the manufacture of battery jars, rain-water conductors, etc.

The New York Electric Subway.

At the meeting of the new Subway Commission, on November 23, the following routes were named as needing immediate construction:—*First*—Fifty-eighth street, Sixth avenue to East River; *Second*—from Brooklyn Bridge through Park row to Mail street, Broadway and Cortlandt street; *Third*—Spring street, from Broadway to North River; *Fourth*—West street, Cortlandt to Dey street, and *Fifth*—128th street and Third avenue to Harlem river.

Although Engineer Thomson, of the construction Co., expressed himself as undecided about the zinc tubes proposed in prefering hydraulic cement to the asphalt mastic covering proposed, the Commission proceeded to order the Construction Company to lay at once zinc tubes in asphalt mastic through 58th. street as proposed by the Averill Company. On the other routes designated above iron tubes are to be laid in hydraulic cement as advocated by the Western Union Telegraph Company.

North Carolina.

All who have seen the fine exhibits sent by the North Carolina State Board of Agriculture to Boston and New Orleans, will wish the people of that State success in their endeavors to introduce capital, immigration and new enterprises into the "Old North State."

One of their latest efforts to acquaint the people of this country with the advantages of the State, was a call for a convention of persons born out of the State. The Bulletin of the State Department of Agriculture, gives a full report of the proceedings in which the capabilities of the State in manufacturing, as well as in lumber and agriculture are mentioned. So far the cotton industry seems to be the principal, as they have nearly eighty mills, with over 4,500 looms and 200,000 spindles.

During the last ten years the manufacture of cotton goods has been increased 11 per cent. in England, 17 per cent. on the Continent of Europe, and 38 per cent. in the United States, a great deal of this last increase being due to the development of new industries in the South.

In the manufacture of iron, the State promises to take a good position, as they have plenty of coal, and among other beds of ore the now famous Cranberry bed, the ore of which is among the purest Bessemer ores in the world. While among the less valuable metals, industrially, are gold, silver, copper, lead and zinc, with very beautiful marbles, deposits of corundum, mica, precious stones, marls and phosphates.

PERSONAL.

ANDREW CARNEGIE, the millionaire manufacturer, who has been dangerously ill in Pennsylvania, is pronounced out of danger.

CHARLES HERRICK, who built the first city water-works at Chicago, died recently at Racine, Wis., at the age of 72.

JOHN ROMINE, with Taylor & Romine, Pittsburg, Pa., is in charge of the surveys of the railroad from Pittsburg, Pa., to Braddock, ten miles.

HENRY T. GALLUP has been appointed General Superintendent of the Boston & Albany R. R. Co., *vice* EDWARD GALLUP, resigned.

C. DELAFIELD, Chief Engineer of the Bienville Water-Works Co., is supervising the construction of the works at Mobile, Ala.

R. A. MATHEWS has been appointed Superintendent of the Road Department, Atlantic & Pacific R. R., *vice* J. E. NELSON, resigned; headquarters at Albuquerque, N. M.

GEORGE MORISON, M. Am. Soc. C. E., of New York City, has been at Memphis, Tenn., in the interest of the Memphis & Kansas City R. R. Co. and the Memphis Bridge Co. to make preliminary surveys for the bridge across the Mississippi.

MR. HARDY, formerly of the Boston & Albany R. R., it is reported, will succeed Mr. I. N. Brewer, as Assistant Chief Engineer of the Lake Shore road after January 1st, next.

LOUIS PARISOE, recently Master Mechanic for the Nevada Central R. R. Co. has accepted the position of Superintendent of Machinery with the Guatemala Central R. R. Co.; his headquarters are at the city of Guatemala.

CAPT. R. L. PYTHIAN, U. S. N., was ordered to duty on November 14, as superintendent of the naval observatory at Washington. Commander A. D. Brown, who has been acting as superintendent, will continue on duty at the observatory as assistant superintendent.

ADAM DREISBACH, a well known railroad contractor, died suddenly at Bloomsburg, Pa., recently, aged 64 years. In 1872 he built the greater portion of the Bound Brook Railroad, and in 1877 built most of the extension of the Delaware & Hudson road to Lake Champlain.

CHARLES A. ASHBURNER, long and favorably known in connection with the Geological Survey of Pennsylvania, has resigned his position as geologist in charge to accept service with a Pittsburgh company. Mr. Ashburner will undertake a systematic search for natural-gas fields for economic purposes.

MARTIN CORYELL, one of the oldest of America's civil engineers, died at his home in Lambertville, New Jersey, early this week. MR. CORYELL was made a Member of the American Society of Civil Engineers on December 4, 1867, the same date of admission as that of Mr. W. W. Evans, whose death is also herewith noted. We expect to give a sketch of Mr. CORYELL'S professional life in another issue.

JAMES STEWART, a well known contractor of Lancaster, Penna., died at Oregon, Wisconsin on November 28. He had been extensively engaged in railroad contracting for many years and did a great deal of work through Pennsylvania and other States. He recently completed a large contract for the Baltimore & Ohio Railroad in the vicinity of Wilmington, Del., and was but recently awarded a contract for thirty-nine miles on a road running out from Madison, Wis., which included a tunnel eleven hundred feet long. It was during his visit to Wisconsin in connection with this contract that his death occurred.

M. F. BONZANO has been appointed Division Superintendent in charge of the Germantown & Norristown branch, and North Penn. & Bound Brook division, Philadelphia & Reading R. R., *vice* I. A. SWEIGARD, promoted to be General Superintendent of the company. The following other appointments have been made: E. F. SMITH, engineer, appointed Superintendent and Engineer of Canals, office at Reading, Pa.; E. CHAMBERLAIN, engineer, assigned to duty under M. F. BONZANO, office at Philadelphia, Pa.; P. A. TAYLOR, engineer, assigned to duty under J. H. OLHAUSEN, Superintendent Mahanoy & Susquehanna Division, with office at Palo Alto, Pa.; I. E. UMSTEAD, engineer, assigned to duty under GEORGE ELTZ, Superintendent Main Line Division, office at Reading, Pa.; W. G. JOHNSON, engineer, assigned to duty under H. W. TRACY, Superintendent Schuylkill and Susquehanna and Lebanon and Tremont branches, office at Pine Grove, Pa.

WALTON WHITE EVANS, a well-known American engineer and promoter of American railway interests, died at his residence at New Rochelle, N. Y., on November 28. Mr. Evans was born in New Brunswick, N. J., about 1816; he was a grandson of Gen. Anthony Walton White, of the Revolutionary war, and his father belonged to an old family of the eastern shore of Virginia. He graduated at the Troy Polytechnic Institute in 1837 Gen. Stephen Van Rensselear, one of the founders of that institution, being a relative of his mother. His first professional work was done upon the Erie canal, from which he entered upon construction on the Harlem railroad. In 1849 Mr. Evans went to Chili as an associate of Mr. Allan Campbell on the surveys for a railroad between Valparaiso and Santiago, and after Mr. Campbell's return, a year later, became chief engineer. He was then successively connected with the Southern railway of Chili, the Copiapo railway and the Arica & Tecna railway, all in Chili. At Caldera he constructed the first ocean pier ever erected on either of the American continents. In 1856 Mr. Evans returned to the United States for a time and was married to Miss Zimmerman, the daughter of the Consul General of Holland to the United States; he had two sons and a daughter, the latter only surviving. After returning to Chili, where he remained until 1860, he settled permanently in the United States and for some years acted as consulting engineer to Henry Meigs in all his vast South American railway enterprises, aggregating $130,000,000; Mr. Evans made out the specifications and contracts for the bridges, engines, rolling stock and material generally consumed in these operations. He was a sturdy advocate of the American locomotive, from first to last, and did very much to extend the fame of this machine in foreign countries. He had competive trials made in Chili about 1857-8, between the American and English types, which created an excitement at the time, the American coming out victorious. Of late years Mr. Evans has had a considerable consulting practice with English engineers and especially with the Australian Government in connection with the introduction into that colony of American locomotives built under his supervision. He was appointed one of the Commission to decide upon the plans for the Hawkesbury bridge, near Sydney, and now being built by an American firm, but ill-health caused him to decline the appointment. He was a voluminous writer; chiefly in pamphlet literature advocating and proclaiming the merits of American manufactures: an extended life of General Kosciusko was the most ambitious effort of his pen. By virtue of his descent from Gen. A. Walton White, he was a member of the Cincinnatus; on December 4, 1867, was elected a Member of the American Society of Civil Engineers, and on December 6, 1870, a Member of the Institution of Civil Engineers.

Engineers' Club of Philadelphia.

Record of regular meeting, November 20, 1886, President Washington Jones in the chair; fifteen members present.

The secretary presented, for Mr. George R. Henderson, a Table of Millimetres and Equivalents in Inches, for the Reference Book.

Mr. John E. Codman presented an account, illustrated by blackboard sketches, of the results obtained from the recent tests of the Efficiency of Different Forms of Boilers now in use by the Philadelphia Water Department. The boilers first tested were four in number, and known as "double-decked," a popular form in Philadelphia, and supposed by many to be an economical steam generator. The lower boiler generally contains about as many tubes as the tube sheet will safely hold; the upper boiler, or drum, is connected to the lower one by two or more necks, and the water is usually carried so as to half fill the upper drum. In the trials mentioned, the height of water was measured from the bottom of the upper drum. For sixteen hours it was kept at 5½ inches from the bottom, and for eight hours at 12½ inches from the bottom. This difference is not very great, but the results obtained show the advantage of keeping the water as low as possible in the upper drum, as, with high water, much that is obtained is only apparent evaporation. An apparent evaporation of 16,000 pounds of water was obtained per hour for the four boilers, which, when corrected, gave only 16,700 pounds per hour. The calometrical tests for quality of steam, made at intervals of thirty minutes, gave over 8 per cent. of water in the steam.

With 5½ inches in the upper drum, an apparent evaporation of 16,100 pounds was obtained per hour, which, when corrected for steam, etc., gave 17,230 pounds per hour. The calorimetrical tests gave 6¼ per cent. of water in the steam. The evaporation of water per pound of combustible, averaged above 9½ pounds for the twenty-four hours. Using 34½ pounds of water from and at 212° Fahrenheit, as the equivalent of a horse-power, the low water gives 500 horse-power, against 486 horse-power for the higher water. The coal used was an ordinary quality of Schuylkill pea coal,

containing about 16¾ per cent. of ashes and clinkers. The second tests were made on the ordinary tubular boiler, set in brick-work and externally fired, arranged so that the escaping gases passed over the top of the boiler and around the steam drum. The boilers were run for twenty-four hours, all water and coal being carefully weighed and checked at the end of each hour; the dampers were kept wide open, and all the coal that could be burned upon the grates with a natural draught in a chimney 60 feet high, was put into the furnaces. The calorimetrical test gave very good results, the average of thirty-nine observations showing $\frac{3}{100}$ of one per cent. of water in the steam. The evaporative efficiency of these boilers was 10⅓ pounds of water per pound of combustible. The rated horse-power of the boilers was 30 horse-power for each, or 60 horse power for the two tested. The horse-power developed, using 34½ pounds of water from and at 212° Fahrenheit, was nearly 100 horse-power.

The secretary announced the death, on October 7, 1886, of Mr. Frank S. Brock, Active Member of the Club.

HOWARD MURPHY, *Secretary and Treasurer.*

St. Louis Engineers Club.

The Club met at 8 10 P. M., November 17, President McMath in the chair; sixteen members and two visitors present. The minutes of last meeting were read and approved. The proceedings of the meeting of the Executive Committee on October 30th were reported to the Club. The executive Committee reported the following programme for the year:

PROGRAMME 1886-87.

Nov. 17. Professor J. B. Johnson, "Earthwork Computations by the Prismoidal Formula."

Dec. 1. Chas. F. White, "Some Tests of Furnace Efficiency." Annual meeting and reports of officers.

Dec 15. Prof. F. E. Nipher, "Economic Coefficient of the Shunt Dynamo." Announcement of result of letter ballot for officers.

Jan. 5. Prof. H. S. Pritchett "Result of Mexican Longitude Determinations." T. T. Johnson, "Discussion of Discharge Measurements in Tunnels under Varying Heads."

Jan. 19. Dr. Wellington Adams, "The Construction of Dynamo-Electric Machinery."

Feb. 2. E. D. Meier, "Evaporative Efficiency of Boilers."

Feb. 16. Robert Moore, "Water-way for Railroad Culverts."

March 2. E. E. Furney, "Compound Oscillating Engines."

March 16.—Edward Flad, "Oscillations of Water in Stand Pipes."

April 6. Dr. C. M. Woodward, "Gas Producers for Ordinary Boilers."

April 20. C. W. Clark, "Experiments on Submerged Adjutages." D. E. Condon, "Experimental Studies relating to Water Supply."

May 4. J. W. Hill, J. T. Monell.

May. 18. H. A. Wheeler, "Relative Economy of Machine and Hand Drilling." Chas. W. Meicher.

June 1. Report of Committee on "Smoke Prevention." Prof. W. B. Potter, Chairman.

On motion the report was adopted.

The applications of Otis Breden, Chas. W. Bryan, Benj. F. Crow, and Wm. L. Seddon, for membership, were read and laid before the Executive Committee.

The Secretary read a communication from the American Society of Civil Engineers on the subject of changes in the organization of that body, and inviting a written communication from the Club on that subject. On motion it was decided to refer the letter to a committee of five, a majority not to be members of the American Society of Civil Engineers. The Chair appointed on this committee: J. B. Johnson, H. W. Baker, E. F. H. Pond, Wm. Bouton and Robert Moore.

The Chair stated reasons for delay in filling the vacancy in the Committee on Smoke Prevention.

The special order of the evening, a paper by Prof. J. B. Johnson, was then taken up. The Professor called attention to inconveniences in using existing methods of computing earthwork by the Prismoidal Formula, as well as certain inaccuracies in them, illustrating his points by models. He called attention to a number of new tables he had calculated for use in such computations, and explained the formula he employed and the method of using the tables. The subject proved of considerable interest and was discussed by Messrs. Holman, Moore, Clark and Bouton.

The Chair called attention to the fact that arrangements should be made for the annual meeting on December 1st.

On motion it was decided that a committee of five on nominations of officers be elected by ballot. The balloting resulted in the election of the following committee; S. B. Russell, Robt. Moore, Chas. W. Melcher, T. J. Whitman, Wm. Bouton.

Adjourned. WM. H. BRYAN, Secretary.

Seventh Annual Convention of the American Society of Mechanical Engineers.

The convention opened on Monday evening, November 29, 1886, at 8.45 o'clock, in the rooms of the Academy of Medicine, 12 West 31st street, New York City.

In the absence of the President, Mr. Coleman Sellers, of Philadelphia, the Vice President, Mr. Henry R. Towne was in the chair. Seated at his side on the platform, was the venerable Horatio Allen, Honorary Member of the Society.

Mr. Towne, made a few remarks regretting the enforced absence of Mr. Sellers, and consequent omission of the annual address, and read a letter from Mr. Coleman Sellers, explaining his presence in England, as due to ill health, and deploring that his physicians had imperatively counseled against any brain-work, and against a trip across the ocean to be present at the convention of the society.

Mr. Towne expressed his pleasure that Mr. Horatio Allen had kindly consented to give an informal talk on the "Early Movement of Mechanics" in this country, in which Mr. Allen had taken so prominent a part. He then introduced Mr. Allen to the assemblage, and the veteran engineer was received with enthusiastic applause. Mr. Allen, who spoke in a conversational vein, entirely off hand, first referred to the early history of railroading, but since the main points on this head, related by him in his characteristic striking way, have, with many others of equal interest, already appeared in his pamphlet "The Railroad Era—The First Five Years of its Development," we need not report his utterances on this subject here, but can refer our readers to the valuable record.

The main portion of Mr. Allen's talk referred to his connection with the early history of steam navigation in this country. Mr. Allen related that he was the first to declare it entirely feasible to use a single engine to go to sea. In view of the fact that this was a departure from English practice, this view was pronounced bold and risky. However, the Novelty Iron Works, of which Mr. Allen was the engineering head, fitted up the "*South Carolina*" with a single engine, and the steamer left New York City for Charleston. When nearing Cape Hatteras, a severe storm set in, and the captain wisely set out to sea, with the result that the steamer did not reach Charleston on the day she was due. The wiseacres already pronounced, and the papers reported that they had said "that it would never do to send a steamer to sea, supplied with but a single engine," but a day later the steamer arrived in first-class condition, the delay was explained, and from that date on, the old notion was exploded.

Mr. Allen spoke of his early advocacy of using steam expansively, even before the date of his connection with the Novelty Iron Works. He used to carry a model under his arm, trying to urge authorities to use steam expansively, but with little success. The Erie railroad would not be convinced by him that it was important to secure more expansion of steam than could be effected with lap and lead of valve. Mr. Allen applied an expansion gear on his own shop engine (Novelty Iron Works), which closely agreed in principle with the link motion, that made its appearance at a later date.

In the matter of surface condensation, though Hall had practically demonstrated its value forty years before the period to which Mr. Allen referred, or about eighty years ago, none the less certain incidental matters had prevented a true appreciation of the value and success of Hall's work, and steamers were not equipped with surface condensers. Mr. Allen desired to put the surface condenser on the *British Queen* of the Collins Line, and advocated this procedure with Mr. Brown, of Brown Brothers, financially interested in the Novelty Iron Works. This firm addressed a friend of theirs in England, Mr. Hamilton of the Soho Works, and in time a report came, the gist of which was not to trouble themselves with surface condensers. Mr. Allen said he had to abide by the decision of Mr. Brown, but that he had then said: "You'll live to see the day, when a first-class steamer without surface condenser will not be on the water." Mr. Allen from this and other experiences drew the conclusion that "frequently where the essentials were entirely right, a little incidental matter or defect, in itself of no account, often prevented the adoption of the right device or system."

So, too, Mr. Allen related how, when desiring to put in an independent circulating pump on a steamer plying between New York and San Francisco, he was first met with opposition. But he insisted on its value, and the independent circulating pump was put in. He was away from New York when the trial trip was made, and some little defect prevented the entire success of the working of the pump. The owners wished to throw out the independent pump, but Mr. Allen begged them to postpone their judgment until the vessel would reach San Francisco. Suffice it to say that no subsequent steamer of the line was built without independent circulating pumps.

Said Mr. Allen: "All we do depends upon the intelligence of those in whose hands we place our work." He considered the evil of our land at the present time to be "that we don't wake up the thinking power of the young race." "We must raise the intelligence of the young men coming into the shops." If he were twenty-five years younger, Mr. Allen would at this date travel all over the land preaching this gospel.

Coming back to the early days of surface condensation, Mr. Allen recounted how he had got the principal man of the Savannah line of steamers to put in surface condensers on two of the steamers, and how after one trip the engineers wanted the tubes taken out. Mr. Allen said: "Let the engineers take the tubes out." One more trip was made, and the engineers clamored to have the tubes back, and changed the jet back to surface condensers.

"The trouble is that so often 'practical' men are placed in position to decide questions they are not fit to deal with." Mr. Allen referred especially to those in charge of the working of the machinery, and stated that higher intelligence was wanted in that line.

After Mr. Allen had concluded, Prof. Thurston proposed a resolution of thanks to Mr. Allen, mentioning how as head of the Novelty Iron Works, Mr. Allen had exerted a beneficent effect on modern steam navigation and taken a share in its development which could not be appreciated to its full extent by any special list of experiences that any one might relate. The motion was feelingly seconded by Prof. Trowbridge, who said that it was his inestimable privilege for four years to work under Mr. Allen's tuition and at his side in the Novelty Iron Works, and who bore warm testimony to Mr. Allen's ability, and to his exceptional character in every relation of life. Prof. Trowbridge's addition, "May the rest of Mr. Allen's life be a happy one" devoutly uttered, found a sympathetic response in the reverent vigor with which the motion was passed.

The meeting then adjourned to a social reception, in which a first class supper did its share to heighten the pleasure

TUESDAY, November 30, 1886.—*Morning Session.*

The meeting was called to order at 10·20 o'clock A. M. Vice-President Henry R. Towne in the chair.

The first portion of the session was devoted to business and to reports of Committees. The report of the Council showed the membership of the Society to be a total of 736, the report of the Finance Committee stated the total receipts for the past year from all sources to be $11,073.07 and placed the expenditure at $10,088.42.

The Library Fund in the hands of the Treasurer is $831.73. The Library Committee reported that the annual subscription account for the maintenance of the library had reached $231, and gave a list of the number of valuable new books, pamphlets and exchanges received during the year.

The Committee to secure the appointment of a U. S. Commission to test materials of construction, which committee consisted of Prof. Egleston, Mr. Woodbury and Mr. Oberlin Smith, reported that despite the promises of Congressmen reported for several years to vote in favor of the bill appointing such Commission, Congress always adjourned before the bill reached the House. "There was no politics in it," that seemed the trouble. The Committee recognizing the fruitlessness of further effort begged to be discharged, which request was complied with by the Society.

The Committee on "Standard Pipe and Pipe Threads," Mr. Geo. M. Bond, Secretary, had a very satisfactory and important report to offer. The substance of this report is contained in the two following resolutions. The first one, passed at a joint conference of the Committee of the Pipe Manufacturers' Association, of the Cast Iron Fittings Association, and of the American Society of Mechanical Engineers, is to the effect "that it is the sense of this meeting that a common standard be adopted and that action proceed first from the pipe manufacturers, and for that reason we recommend that it should be particularly brought to their attention at their meeting, to be held at Pittsburg, October 27, 1886." The second resolution passed at said meeting to the effect "that the Wrought-Iron Pipe Manufacturers of the United States hereby adopt the Briggs standard of gauges, and that where any manufacturer has, from any cause, got away from that standard, he be requested to get such corrections made as soon as possible, so as to conform to the Briggs Standard."

This implies a general re-adoption of the Briggs standard for all steam, water and gas pipes, and a conformity to same by all manufacturers interested. We learn that the Pratt & Whitney Company, of Hartford Conn., are already making the gauges for a number of the manufacturers.

The report of the Committee called forth some discussion.

Mr. Kent suggested the incorporation of the table setting forth the Briggs standard as part of the report, or as an appendix thereto, so that the whole information necessary would be available to the membership in the Transactions. To this request Mr. Bond acceded, stating that the final report should contain these data.

Mr. Oberlin Smith wanted to know if the valve manufacturers had been addressed, which was answered affirmatively. He also inquired whether the English engineering authorities had been communicated with, in the hope of securing the same international standard. The desirability of this was also emphasized by Mr. Sterling, who spoke of a recent pipe shipment to Australia made by him in which it became necessary to cut the thread on one end, but to leave the other unthreaded, so that the other thread might be cut in Australia to such standard as they there saw fit.

In reply the Secretary, Prof. Hutton, read a letter received from Dr. Cheney, of London, Warden of the British Standards, requesting copy of the Report of the Committee on Standard Pipe and Pipe Threads, expressing his appreciation of this work and his desire to further this good work in England.

Mr. Kent's resolution of thanks to the Committee was promptly seconded, and carried by acclamation.

The Committee on Uniformity of Methods of Tests of Materials of Construction reported that in order to secure such methods and records of test that the test work may be made comparable, letters had been addressed to ten or twelve engineers in charge of different testing machines, sending them uniform specimens of the same material for test and requesting reports. The records were so varying in their nature that Mr. Henning, of that Committee, had to devote fifty different columns of a table to include all the data received and naturally there was no chance, with such varying style of record, to reach general deductions from the returns. The Committee had prepared a proposed standard form of blank for reporting test, and had sent these forms, with uniform test pieces, to twenty-five engineers in charge of testing machines, and hoped ere long to receive returns, and criticisms of this blank which would enable the Committee to prepare a standard from of blank, acceptable to all testing engineers. The Committee was continued.

The tellers announced the election of the following officers for the ensuing year:

President: Mr. George H. Babcock. *Vice-Presidents*: Mr. Joseph Morgan, Mr. Charles T. Porter, Mr. H. S. Smith;

Managers: Mr. F. G. Coggin, Mr. John T. Hawkins, Mr. T. R. Morgan, Sr.;

Treasurer, Mr. Wm. H. Wiley.

The efficient Secretary of the society, Prof. F. R. Hutton will, of course, continue in office.

The first paper of the session, that of Prof. Realeaux, on "Friction in Toothed Gearing" was then read.

This was a theoretical discussion of all the elements involved in the problem, practical questions of wear of teeth being also considered. The subject was treated in the eminent author's characteristic style, higher mathematical methods of analysis being freely used. The paper does not admit of an abstract, and must be studied in its entirety by the specialists interested.

It was discussed by Messrs. Lewes, Bilgram, C. A. Smith and Sterling, who expressed many differences of opinion.

The next paper was that of Prof. R. H. Thurston, on the "Friction of Non-Condensing Engines." The main points of this paper are presented editorially in this issue.

The discussion opened with a written communication from Mr. George H. Barrus, in which he endorsed the principal conclusions reached, and in support of the general proposition advanced, cited his experience with a Corliss engine, which showed the following record:

	Indicated Horse-Power.	Brake Horse-Power.	Difference.
Unloaded	12.2	0	12.2
Loaded	72.8	60.4	12.4
	101.9	89.7	12.8
	109.5	106.0	13.9
	133.3	121.5	11.8
	145.4	133.0	12.4
	148.4	144.8	13.6

Mr. Barrus also instanced the case of a Westinghouse engine, making 350 revolutions, 60 (?) pounds initial steam pressure, which, when loaded to 44.1 horse-power, showed an expenditure for friction of engine equal to 6.1 horse-power, loaded to 34.6 horse-power a friction of 5.16 horse-power, and loaded to 25.3 horse-power, a friction of 6.3 horse-power.

Prof. Lanza stated that the experiments made in the mechanical laboratory of the Massachusetts Institute of Technology seemed to support the view that friction was independent of load. Mr Wolff expressed it as his opinion that of late years De Pambour's proposition had been discarded and the view had been generally held by all engineers, that given the same initial pressure and the same rate of revolution, the engine friction was independent of amount of load. The fact that in the measurement of power indicated, cards were taken with full load, and then with the engine unloaded, and the difference counted as the load, was a proof that engineers had not considered that the amount of friction of engine varies with load, or such practice would have been inadmissable.

Mr. Kent expressed it as his belief that the friction of piston-rings was one of the main items in the total friction account of engines.

In reply to a query why Prof. Thurston held that with non-condensing engines the case might, or probably would, be different, the professor stated that the work of air-pumps and circulating pumps would vary with the amount of water circulated, which amount of water would in turn vary with the load, since more steam would have to be condensed as the load increased and steam consumption increased. The professor also believed that had the engine experimented with by him been of the unbalanced slide-valve type, the result might have been different.

Mr. A. Wells Robinson's paper on "Dredging Machinery," next in order, is printed in full in this issue of ENGINEERING NEWS.

In discussion, Mr. C. C. Hill stated his preference for wooden boxes for journals instead of leather and rubber, and Mr. Towne made some interesting comments on the relative merits of endless bucket dredges as compared to the ordinary bucket or grapple dredges. The former were always used in England, but had made little headway in this country. Mr. Towne did not consider them, on account of their size, suitable for use in many places where the ordinary dredge has its main use, around docks, inside of slips and the like where the dredge had necessarily to be satisfied with comparatively small quarters. As to cost, while admitting that theoretically the figures might be in favor of the endless bucket dredge, Mr. Towne knew that practically the horse-power required and its cost were quite as great as with the ordinary dredge.

At 1.30 the session adjourned to a fine lunch and a pleasant social gathering in the basement of the building.

Afternoon Session.

At 2.45 the afternoon session opened with Topical Discussion No. 36, "How Should a Laboratory of Mechanical Engineering be Equipped?"

Prof. Lanza thought the laboratory should be so equipped with testing apparatus, steam engines, boilers, dynamometers, indicators, gauges and the like, that the student should gain experience in those kinds of tests which he would be called upon to perform when he entered practical life. Inasmuch as the conditions were different when the apparatus was on a reduced or miniature scale, Prof. Lanza favored everything being done on the scale of practice, so that the student when he entered practical life, would not have to make allowances and changes involving difficulties. Furthermore Prof. Lanza believed that inasmuch as the student should receive drill in original investigation, co-operation of laboratories of engineering of different schools would enable the solution of many unsettled important questions, each laboratory attacking a different phase of the problem, without overlapping each other in their efforts. The special equipment would differ with every school.

Prof. Alden desired the practical engineers present to state what class of work they expected the young graduates to perform when they entered their employ. This would have a strong influence on the equipment of laboratory and other features of the course.

Mr. Towne said the matter was too vast a one to specify. The main thing to effect by the laboratory of engineering was to teach the young men, not to do some special work needed or in which they were engaged, but to train them how to go about to investigate any subject, and to attack any problem of practical work. In other words, to teach them to think, and how to help themselves.

The next topical discussion, "What are the Best Problems for Students in Mechanical Engineering in the Last Year of their Regular Course?" was closely related to the previous one.

Mr. Crane said the difficulty he had found with young graduates in his employ at various times, was that they had not had experience in design, and had little knowledge of proportion of parts. He believed that in the last year of the course the students should be called upon to make simple, independent designs, such as a simple tool, a pedestal and the like, using their own judgment. Then the instructor should call attention to defects of the several designs presented, and thus the students would gain the information of proportion of parts and design, which they now seemed to lack on graduation.

Mr. Kent believed that this work should be taken up in junior year, and the senior year devoted to the most difficult problems of theory, such as drill in thermodynamics, etc. In fact, the senior year should give the student a class of knowledge which he could not obtain, and possibly not require in practice, until ten years after graduation. The senior year should be the most difficult one of the course. But to effect this course he advocated it was necessary to raise the standard of admission, and the calibre of the work pursued in the Freshmen and Sophomore years.

Mr. Henning instanced the Stevens Institute as carrying out the plan sketched by Mr. Kent.

Prof. Lanza mentioned that at his school, the Massachusetts Institute of Technology, separate designs of simple machines and their criticism by the class and the instructor, formed a leading part of the last year's course.

Prof. Alden also advocated the drill in design of simple machinery, for this was the only class the graduate would generally be called upon to work out for a number of years after leaving school. It would take ten years before he was in independent charge of complex work, and by that time his outside practical training would have given him the required knowledge. It was a mistake to attempt to teach the design of the most complicated machinery, as was sometimes done, in technical schools.

To the conundrum, "Can you Give any Data from your own Experience as to the Power Required to Drive Modern American Machine Tools?" Mr. Babcock replied that a rule of thumb, of the older class of engineers, which he had found applied closely, was to allow one horse-power of engine for every ten men at work in the shop. This would meet the demand of the power required by the machine tools operated by them.

Mr. Doane believed this might be a good rule for olden times when cuts of metals averaged $\frac{1}{8}$ of an inch at slow speeds, but that at present time, with machine tools making cuts of $\frac{1}{4}$, $\frac{3}{4}$ and $\frac{7}{8}$ inch, one horse-power of engine to every two men employed would be nearer the truth. In his own shop, employing 300 people in the manufacture of wood-working machinery, the engine never developed less than 150 horse-power, usually 200 horse-power.

Mr. Babcock, in support of his view, instanced the Singer Manufacturing Co., who only require a 300 horse-power engine to do their work.

Messrs. Falkenau, Towne and others pointed out that much of the power ordinarily charged to the machine-tools, was really chargeable to the other appurtenances of the shop, such as fans, blowers and the like. Mr. Falkenau mentioned his experience at Leadville, where by actual measurement he had found that of the 17 horse-power consumed in his shop, 12 were used by a Sturtevant blower.

Mr. Towne, of the Yale & Towne Manufacturing Co., said that their shops, employing 500 hands, required 120 to 150 horse-power, but that half of this amount was consumed by blowers, and by friction of shafting.

Messrs. Couch, Lewis and others engaged in the construction of machine-tools maintained that the power required depended upon so many points in the tools themselves, and in the work they performed, that specific data were not at hand.

At this point the vice-president announced that the valuable collection of scientific apparatus owned by the late J. C. Hoadley, (offered for sale by the executors at about $500,) had been purchased by Mr. Stephen W. Baldwin and presented to the society. The society expressed its cordial thanks to Mr. Baldwin for the gift, which, valuable in itself, would also prove a precious memorial of their departed member, Mr. Hoadley.

Prof. Lanza then read his paper on "Strength of Shafting Subjected to Both Twisting and Bending." This is an account of the work done upon this subject in the laboratory of applied mechanics of the Massachusetts Institute of Technology. It describes the experimental machinery used, tabulates the results thus far attained and presents some interesting conclusions, among them, that "it seems fair to conclude," that "in line shafting or in most cases of head shafting, the breaking is even more liable to occur from bending back and forth than from twisting, and hence, that in no case ought one to omit to make a computation for the bending of the shaft as well as the twist."

In discussion, Mr. Kent supported Prof. Lanza's views, and made reference to an experience with a wrought-iron shaft, which subjected to repeated alternate strains had only lasted six months and then broke with a fracture, the fibres resembling a broom in structure.

Mr. Henning mentioned that Mr. Baker's paper, which we will publish in next week's issue, showed up similar results to those recorded by Prof. Lanza. They indicated that it is the superposition of strain which becomes the true test of the metals' strength, not the ultimate strength or ductility under one class of steady strain. Oft repeated alternate strains caused rupture of metal even when elastic limit of same had not been reached.

Mr. C. C. Hill had had the same experience with duplication of strains, in saw mill machinery practice.

Mr. Towne, commending Prof. Lanza's investigation, suggested that tests of similar kind be made, in which the shaft be not strained to its breaking limit. The length of shaft and the different vibrating action depending upon length, entered the problem, and should receive consideration.

The next paper was that of Prof. Alden giving

"Formulæ and Tables for Calculating the Effect of the Reciprocating Parts of High Speed Engines."

This paper embodied, in the shape of formulæ and tables, the writer's researches of the effect of the reciprocating parts of an engine upon the pressures transmitted to the crank pin at different points of its path. The tables will undoubtedly prove useful in the practical design of engines.

The paper received some discussion by Messrs. Lewis and Lanza.

In the absence of Mr. Barrus, the Secretary read the former's paper on "The New Calorimeter."

This gives the record of several practical trials, in boiler tests, of the new apparatus for determining the amount of moisture in steam, which Mr. Barrus described at the last Annual Convention of the Society. It will be remembered that this new method consists in evaporating the moisture held by the steam, and measuring its quantity by determining the amount of heat required for that purpose. This amount of heat is determined by the difference in the degrees of temperature of superheated steam before and after giving off sufficient heat to the wet steam to convert it into dry steam. The flow through standard orifices determines the amount of superheated steam and wet steam supplied, without need of weighing these quantities. The various data of practical tests presented by Mr. Barrus show a uniformity of result and a consistency of action, which go far to sustain the value of this calorimeter, and to definitely dispell such objections as were cited against it at the previous convention.

There was no discussion.

The session closed with topical discussion No. 27: "What are the best Conditions for Flying Rope for Transmission of Power, are there Limitations to its Use?"

Mr. Sterling was quite definite in his view that his experience, in the use of wire-rope, transmitting power from a large water-wheel to a blacksmith shop, had convinced him that he did not care to try it again.

Mr. Giddings related the experience of Prof. Sweet at Sibly College, Ithaca, in the transmission of power 1,100 feet by means a ¾-inch wire-rope. It took two or three years to find out how to run the rope and prevent the large amount of vibration. After vainly looking for the cause of vibration, the rim of the wheel and the grooves were turned true, and the wheels rebabitted, and thenceforth there was no trouble. Any slight irregularity in the truth of wheels and grooves would cause dangerous vibration of the wire rope, but with accuracy assured in place, the system answered well.

In their own shops, Mr. Giddings had in successful use manilla rope, 1¼ inch in diameter, transmitting about twenty-five horse-power, 250 feet. The grooves of the wheel were lined with alternate layers of rubber and leather, and the rope was soft and pliable. It was necessary to state to the manufacturers the special use for which rope was required, then there would be no difficulty.

Mr. Towne spoke in favor of cotton rope transmission, a mixture of beeswax and black lead were proper coating to use.

Dr. Hutton spoke of Prof. Realeaux's strong, if indeed not extreme, advocacy of the use of rope transmission, an account of which would be found in a volume recently contributed by the Professor to the Library.

It was 5:15 o'clock when the meeting adjourned.

Fortunately for the Managers of the American Institute Fair, who had placed 150 tickets at the disposal of the membership, it rained quite heavily in the evening, so they could credit the slim attendance of the mechanical engineers to that source. As a fact we know by interviewing the membership that had the weather been fair, they would not have attended in greater numbers, for they were tired of seeing the same old-time machinery exhibits, that have been the glory (?) of the American Institute Fair for the past decade.

Western Architects.

The Third Annual Convention of the Western Association of Architects was held in Chicago on November 17th, 18th and 19th, at 15 East Washington street.

President D. Adler occupied the chair and delivered the annual address to a large representation of western members of the profession.

L. H. Sullivan, of Chicago, read a paper on "Inspiration"; Health Officer DeWolf, of Chicago, read a paper on "The Relation of State Medicine to Architecture"; S. J. Artingstall, City Engineer of Chicago, read a paper on "Proportion of Joints and Connections in Framed Structures"; Prof. N. Clifford Ricker, of the Illinois State University at Champaign, read a paper on "Architectural Grammar," and Mr. Isaac Hodgson, of Minneapolis, followed with one on "Hints on a National Style in Architecture"; Mr. E. H. Ketcham, Indianapolis, read a paper on the "Architecture of Indiana Insane Asylums"; The Association recommended the adoption of the Metric System of Weights and Measures, and a Committee was appointed to correspond with other associations on the subject and join with them in a petition to Congress to enforce the law on the subject.

The "official organ" was discontinued for the present and the following officers were elected:

President, John W. Root, Chicago.
Secretary, J. F. Alexander, Lafayette, Ind.
Treasurer, S. A. Treat, Chicago.

Directors, George W. Rapp, Cincinnati; Charles Crapsey, Cincinnati; D. Adler, Chicago; G. W. Goodwin, Minneapolis; C. A. Curtin, Louisville.

The next meeting will be held in Cincinnati, O.

The meetings of the Association were held in the Assembly Room of the Permanent Exhibit of Building Material, a private enterprise of Mr. Henry Lord Gay, a well known Chicago architect, who has thus furnished excellent facilities for manufacturers of all classes of building material to exhibit their wares at the most suitable occasions as well as all the time. These facilities have been liberally availed and our correspondent has noted among the multitude of excellent exhibits a few as follows: The Hecla Architectural Bronze and Iron Works, 157 La Salle street, Chicago; Albert A. Riley, 178 Wabash avenue; C. J. L. Meyer & Sons Co., 133 Wabash avenue, who exhibit mantels; J. N. Raymond, 55 and 57 West Lake street, manufacturer of lead pipe, sheet lead, solder lead, traps and other goods in that line, being a leading dealer in lead supplies; Lockwood & Kimbell, 162 East Washington street, and Wm. E. Hinchcliff made a good display of bricks; the Northwestern Terra-Cotta Works and W. D. Gates exhibited terra-cotta goods; the Chicago Mastic, Lead & Oil Co. had a display of their "Liquid Cottage Colors"; the American Endolithic Co., 125 Fifth avenue, New York, and 175 Dearborn street, Chicago, exhibited their new process of decorating marble.

CORRESPONDENCE.

The Pedestal of the Statue of Liberty.

EDITOR ENGINEERING NEWS:

In your article on the Statue of Liberty, in the number of your Journal of Nov. 20th, I think you do scant justice to your own journal, or to its contributors, as follows. You say, "about this time (Nov. 1884) some controversy arose as to the proportionate height of the pedestal and the Statue itself." and you indicate, that at this date, for artistic effect, "the pedestal was redesigned and lowered as at present built." And then you refer to the article of April 18th, 1885, in ENGINEERING NEWS, as in the light of an endorsement, or certainly as written subsequent to and in full knowledge of this change in the height of the pedestal! Whereas you well know, that up to this date at least, the original pock-marked pedestal, to its full height, was on sale under the auspices of the committee, as the veritable model of the monument that was to be, and I have before me now, a cut in the *World* of 20th April, 1885, accompanying an appeal to the people for their dimes, wherein the statement of Chief Engineer Stone stated as interviewed by the *World* the day previous, distinctly makes mention of what had been accomplished, and what remained to be done, in terms of *courses of masonry*, wherein it will appear, that according to said Stone's statement, it was then the intention to carry the pedestal to the height originally designed, as shown in the statuettes then for sale, and offered to the public as a miniature of what the completed work would be; and I risk nothing in saying, that *you knew*, that if the funds had not given out, it would have been so completed. You will understand me, I do not claim that the article in your journal of 18th April has anything to do with lowering the height of the pedestal: on the contrary, from what I knew of the committee, had your article been read by them, my belief is that the original plan would have been carried out to its full height. But I claim that at the date mentioned, it never had been questioned by anyone outside of the committee, that the pedestal was not perfectly appropriate, and suited in every way to the best effect of the statue, as a work of art. And that your journal was the first publication to advocate in the interest of art purely, a reduction in the then advertised height of the pedestal.

J. W. A.

A Correction.

EDITOR ENGINEERING NEWS:

There is a slight inaccuracy in your obituary notice of H. M. Hoxie. Mr. Hoxie was not General Superintendent of the Union Pacific Railroad during its construction. He was the nominal head of the "Hoxie Contract" the first of the three great contracts under which the *Credit Mobilier* built the Union Pacific Railroad, and he subsequently brought a suit for either additional salary or a portion of the profits. The other two were the "Ames" and "Davis" contracts.

Mr. Hoxie however was assistant Superietendent to W. Snyder till near the completion of the road when Mr. Snyder was superseded by Colonel Hammond formerly of the Chicago, Burlington & Quincy, when Mr. Hoxie went to Texas with an engineer named Evans, who had been employed on the Union Pacific Railroad, and went there as Chief Engineer of the International Railroad.

The Engineer and General Superintendent of Construction on the Union Pacific was Samuel B. Reed, Mem. Am. Soc. C. E., now of Joliet, and it was under his energetic management that 535 miles, from near Sherman to the Promotory, were built in one year and twenty days.

Yours truly,
EDWARD P. NORTH.

Combined Reed and Plaster as a Building Material.

The *Journal du Ceramiste* describes the following novel building material as manufactured by Geraudi Brunner & Co., of Paris:—

Upon a horizontal table four or five plates of metal, of any convenient size, are set on edge at any distance apart desired for the thickness of the plaster slabs to be made, say 3 or 4 inches; upright slats at the ends complete the moulds. Into these moulds plaster of paris is poured alternating with layers of reeds in such manner as to leave no interstitial spaces; and when filled and the plaster set, the confining plates are removed and the product dried.

This simple fabrication furnishes an excellent building material, a cubic metre (35 cubic feet) weighing only about 1,771 pounds or about 50.6 pounds per cubic foot. The space occupied by the reeds is equivalent to 50 per cent. of the volume. The resulting plates are accurate in form, solid, light and incombustible; they transmit neither heat nor sound; they are easily and rapidly put into place, being nailed together like wood, and the partitions made with them are dry.

The price named is 10 cents per centimetre thick per metre square; or in round figures 10 cents for a slab 39 inches square and $\frac{4}{10}$ inches thick, and thicker sheets in proportion. They are spoken of as well adapted to the formation of warm air conduits and ventilating channels.

In order to render paper as tough as wood or leather, a plan has been devised which, it is said, effectually accomplishes that purpose, namely, by combining chloride of zinc with the pulp in the course of manufacture. It has been found that the greater the degree of concentration of the zinc solution the greater will be the toughness of the paper, and that it is thus serviceable for making boxes, combs, etc.

WATER.

(For further items see page V.)

ARTESIAN WELL.—The Empire Artesian Well Drilling Co. (whose card appears in another column) has just finished drilling a 12-inch well, 475 feet deep, at the United States Assay Office, Wall street, New York City, which yields about 200 gallons per minute, and which will be the means of saving the government several thousand dollars annually in water taxes. This well is reported to be the most satisfactory and abundant that has ever been put down in the lower part of the city. Mr. Andrew Mason, the Superintendent at the Assay Office, speaks in the highest terms of the skill and ability displayed by this company in prosecuting such work, and highly recommends them to any desiring artesian wells as doing reliable skilled work at lowest rates.

ALLEGHENY, PA.—The City Comptroller will advertise for bids for a filtering system with a capacity of 20,000,000 gallons per day. The following is an analysis of the water: free ammonia .0002, albuminoid ammonia, .0120; chlorine, 2.0568; solid matter, 11.1440; nitrates, trace, nitrites, none. There is an undue proportion of organic matter, 80 per cent. of which, it is claimed would be taken up by the Hyatt filters.

MEMPHIS, TENN.—The water-works are to be purchased by a syndicate headed by Samuel R. Bullock, of New York City. The price to be paid is $350,000 in cash for the stock and $100,000 outstanding bonds to be taken up, a total of $450,000. A new plant will be erected about two miles from the present site, and four pumping engines will be put in, with a capacity of 20,000,000 per day; there will be several settling basins with a capacity of 600,000 gallons each, and the water will be pumped from the basins into a standpipe 150 feet high and 25 feet in diameter. The works will cost $1,500,000 and will be completed in 18 months if a satisfactory agreement is made with the city authorities. The city now pays $6,000 per annum for water for sanitary purposes, and has a 16 year contract with the old company which contract is claimed to be binding on the new company. The new company has made a proposition to furnish the city with clear water, instead of the present muddy supply, for $30,000 per annum and to sell the works to the city at the end of ten years. The Citizens' Water Co. has been reorganized; President, S. R. Bullock; Vice-President, Nolan Fontaine; Treasurer, F. Waltman; Secretary, W. H. Moore; Directors, N. M. Jones, J. N. Snowden, W. D. Wilkerson, H. M. Hill, E. F. Miller and S. H. Brooks.

ST. JOHN AND PORTLAND, N. B.—Gilbert Murdoch, M. Am. Soc. C. E., chief engineer and superintendent of the sewerage and water-works of St. John and Portland, has issued his report, dated April, 1886, for the year 1885. The works were reported to be in good condition, some repairs and improvements having been made. The supply is taken from Latimer lake, Elderslie brook and Hazen brook, and the aggregate capacity is about 6,000,000 gallons per day; the average daily consumption was about 5,000,000. The quality of the water is good. There was very little trouble from anchor ice during the winter. The city distribution system was increased by 5,060 feet of mains; 333 feet of 2-inch pipe, 558 feet of 4-inch, 1,285 feet of 7-inch, 725 feet of 8-inch, and 2,159 feet of lead pipe, .5 to .75-inch diameter, for house supply; 396 feet of mains were laid in St. Jonh, and 2,505 feet in Portland. The total pipeage of the water supply of St. John and Portland at the end of 1885 was 366,298 feet; 245,415 feet of main pipe, 119,867 feet of service pipe, and 1,016 feet for free hydrants; the distributing mains were from 2-inch to 15-inch diameter, and the service pipes from .5-inch to 3-inch diameter. There are 753 stop-cocks on the main piping, and 4,043 on smaller mains, service pipes and hydrants; there are 40 free hydrants and 282 fire-plugs, 152 in St. John and 130 in Portland. The following meters are in use, indicators, 2; Worthington, 94; Crown, 35; Hersey, 1; total, 132; nine of these were put in during the year. Certain extensions are recommended.

No additions have been made to the main sewers, the lengths of which are 72,763 feet of the new, and 23,000 feet of the old system, not including gullies. The system comprises 18,252 feet of timber sewers, from 21 by 12 inches to 48 by 27 inches; 1,475 feet of plank sewers, from 6 by 6 inches to 18 by 14 inches; 52,162 feet of stoneware pipe sewers, from 6 to 18 inches diameter; 706 feet of iron pipe sewers, from 8 to 24 inches diameter; 159 feet of brick sewer, 30 inches diameter, 5,754 feet of stoneware and iron pipe from gullies, 500 feet of old brick sewers, and 23,000 feet of old plank sewers; total, 102,008 feet. There are 369 gullies and catch basins. Some extensions are recommended.

PIPE LAID.—C. E. Gray, Jr., has laid eight miles of cast-iron pipe at Escanaba, Mich., for the new water works built by Messrs. Moffett, Hodgkins & Clarke, which are about complete, and will furnish fire protection. He has also laid nine miles of pipe at Pekin, Ill., for C. A. Lamb, of Chicago.

THE HYATT FILTER.—Mr. John Hyatt recently explained to a meeting of the Newark, N. J., Aqueduct Board and the Water Committee of the Council, the plan by which it is proposed to purify the water by means of a $225,000 filtering plant. It is proposed to put in six filters. The matter met with much encouragement and it is to be laid before the City Council shortly.

NEWS OF THE WEEK.

Contracting.

(For further items see page XIII.)

Dredging.—The following bids were opened December 1st, at the office of the Department of Docks, New York City, for dredging in the North and East rivers: Union Dredging Co., 20 cents per cubic yard; Morris & Cummings Dredging Co., 22.5 cents.

Drainage Works.—The following bids have been received at the City Engineer's Department, Boston, Mass., for the main drainage works, Section 6, South Boston: M. J. Collins, Boston, $16,800.50; Putterill & Killian, Boston, $13,230.50; E. F. Brigham, Somerville, $12,166.

Dredging.—The following proposals have been received by Lieut. Col. Walter McFarland, U. S. Engineer Office, New York City, for dredging in the channel between Staten Island and New Jersey; amount, 70,000 cubic yards: Thomas H. Benton, 29¾ cents per cubic yard, $20,912.50; P. Sanford Rose, 32 cents, $22,400; W. H. Beard, 32½ cents, $23,450; Elijah Brainard, 37 cents, $25,900.

Water Works.—Proposals were opened recently in Oberlin, O., for the construction of water-works. There will be a storage reservoir, 100 by 155 feet at top and 66 by 100 feet at bottom; a well 30 feet in diameter and 20 feet deep; brick pump house, 30 by 50 feet, with smoke-stack 75 feet high and 8 by 8 feet at base; 21,000 feet of 10-inch, and 6,000 feet of 8-inch vitrified pipe; 25 10-inch and 10 8-inch branches; 1,150 feet of 10-inch and 50 feet of 8-inch iron pipes; and ten water gates, six 10-inch and four 8-inch. Bids for vitrified pipe were received from the Columbus Sewer Pipe Co., Columbus, O.; American Sewer Pipe Co., Akron, O.; American Sewer Pipe Co., Columbus, O., and Carter & Hatch, Oberlin, O., at the following prices: 10-inch pipe and branches, 21 cents; 8-inch pipe and branches, 14 cents; also from Francey's Sons, Toronto, O., at 15 cents for 8-inch pipe, and 84 cents and 56 cents for branches.

The following were the bids for piping complete: Phillip Sullivan, Fremont, O., $11,937.80; W. H. Crook Massillon, O., $11,950; House, Otis & Arnold, Norwalk, O., $11,998.48; A. L. Holmes, Grand Haven, Mich., $12,195.50; M. Callan & Co., Sandusky, O., $12,475 75; Benjamin Thompson, Urbana, O., $13,075; Clements Bros, Cleveland, O., $14,534; W. M. Chisholm, East Liverpool, O., $14,721.30; E. J. Green & Son, Buffalo, O., $16,423.25; Kerr & Schandler, Cleveland, O., $18,990; Doerzback & Decker, Oberlin and Sandusky, O., $19,100; Wm. H. Myers & Son, Hillsdale, Mich., $19,842.

The following were the bids for well and reservoir, brick and stone respectively: Doerzback & Decker, $1,279 and $1,143; M. Callan & Co., $1,077.50 and $822; Phillip Sullivan, $912.50 and $852 50; Kerr & Schandler, $1,280; W. M. Chisholm, $1,300; Benjamin Thompson, $1,460; Wm. H. Myers & Son, $1,997; A. L. Holmes, $2,077.

The following were the bids for the pump house: Benjamin Thompson, $2,090; W. H. Myers & Son, $2,990; Doerzback & Decker, $3,300; Water & Gas Works Construction Co., Pittsburg, Pa., $3,500.

Proposals will soon be advertised for the pumping machinery.

Car Shops.—Chief Engineer Whittemore, of the Milwaukee & St. Paul R. R. Co. has completed plans for brick car shops at Austin, Minn. The main building will be 200 by 150 feet. Cost, $450,000. Work to be commenced at once.

The American Institute of Architects held the first session of its convention on Wednesday in the directors' room at the Mutual Life Insurance Company's Building. President T. U. Walter, LL. D., presided, and among the prominent architects present were Alfred Stone, of Providence; George A. Frederick, of Baltimore; C. A. Wallingford, of Indianapolis; Warren R. Briggs, of Bridgeport; M. E. Bell, Supervising Architect of the United States, and Richard M. Hunt, C. W. Clinton, N. and Pierre L. Le Brun, O. P. Hatfield, James Renwick, and Henry F. Kilburn, of New York City.

The Keystone Bridge Co., Pittsburg, Pa., has contracts on hand for the ironwork for the Carnegie Library building at Braddock; a train shed at Milwaukee, Wis., for the Chicago, Milwaukee & St. Paul R. R. Co.; the Third street bridge, at St. Paul, Minn., for the same company; and a railroad bridge at Kansas City, Mo.; also for various other works at an aggregate cost of between $1,000,000 and $2,000,000.

Jersey City Elevated R. R.—The Keystone Bridge Co., Pittsburg, Pa., has been awarded the contract by the New Jersey Railway Construction Co., for the construction of an elevated railroad in Jersey City. It will be three miles long, double track, and will cost $2,000,000. There will be 120 spans of iron-plate girders and the aggregate weight of the iron and steel will be about 750,000 pounds.

Street Work.—The Warren Scharf Asphalt Paving Co. was the only bidder for work at Central avenue, New York City, at $8,608.50; the prices bid and totals were as follows: 5-inch granite curb, $1.30 per lineal foot, $578.50; resetting 6-inch and 8 inch curbs, 10 cents per lineal foot, $48 and $10; granite blocks, $4 50 per square yard, $312; laying asphalt, $3 per square yard $6,150; flag gutters, $1.10 per lineal foot, $1,210.

Sewer.—The following bids were received November 30th by Samuel L. Smedley, Chief Engineer and Surveyor, Philadelphia, Pa., for the Manayunk intercepting sewer: the contract, amounting to $50,000, was awarded to James Sullivan.

	Sewer, 12 brick rings, per lin. ft.	Sewer, 18 brick rings, per lin. ft.	Sewer, (cast-iron) per lin. ft.	Four connections across canal.	Additional rubble masonry per cubic yard.	Concrete per cu. yard.	Additional 12" pipe per lin. ft.
	$	$	$	$	$	$	$
James Sullivan	16.85	17.85	17.85	5,806	4.50	7.50	2.50
James Deehan	18.00	20.00	18.00	6,4-0	7.00	7.00	3.00
B. E. Malone	18.50	18.50	19.75	7,191	5.00	6.00	1.50
M. C. Hong	21.00	24.00	18.00	7,300	9.00	9.00	2.25

Army Buildings.—The following proposals have been received for the construction of building at Fort Porter, N. Y.; the bids are for guard house and for barracks and administration building: Wm. M. Savage, $4,086, $27,032; W. R. Haven, $5,336, $35,478; John Druar, $3,694, $30,052; Runwill & Rupp, $3,500, $28,300; Jared H. Tilden, $4,350.56, $29,883; Albert J. Hoffmeyer, $3,809, $28,585; M. McNamara, $4,027, $28,398; Jacob Reimann, $5,367, $34,764; Henry N. Smith, $3,960, $27,603; Charles Berrick, $4,445, $27,420; John Hoeffler, $4,500, $26,568; Joseph Churchyard, $4,586, $28,739 (all these are Buffalo, N. Y., parties); Marcellus & Cheney, Oneida, N. Y., $5,978.50, $32,236 22; William Dickison, Syracuse, N. Y., $3,667, $31,855; Moses R. Harris, Newport, Ky., $5,500, $32,388; James L. Lowry, New York City, $6,941, $38,697.

The New Cruisers.—The Secretary of the Navy has awarded the contracts for the new cruisers and gunboats as follows: Cruiser No. 2, *Charleston*, Union Iron Works, San Francisco, Cal., $1,017,500; cruiser No. 3 *Baltimore*, Cramp & Sons, Philadelphia, $1,325,000; gunboat No. 2, Columbia Iron Works & Dry Dock Co., Baltimore, Md., $247,000. The Union Iron Works, San Francisco, put in the lowest bid on cruiser No. 1, *Newark*, but as the figures exceeded the maximum amount fixed by the appropriation bill, the Secretary could not award them the contract. He will probably refer the matter to Congress and recommend that the appropriation for cruiser No. 1 be increased, or that the Navy Department be authorized to build the cruiser at one of the navy yards. In the case of gunboat No. 1, no decision has been made between the bid of Reeder & Sons, Baltimore, who propose to build the vessel in accordance with the plans of the department, and the bid of Cramp Bros., Philadelphia, who propose to construct the engines after their own designs.

Railroads, Bridges and Canals.

(For further items see page XV.)

Artesian Wells for Railroad Service.—The Empire Artesian Well Drilling Co., 38 Gold street, New York City, is drilling a well, 1000 feet deep, for the Long Island R. R., Co. at their depot yard at Long Island City. The means of obtaining the necessary water supply, particularly at tank stations, has been very largely adopted by nearly all the leading western railroads of late years, it having been demonstrated that it is the most abundant and reliable, and by far the most economical source of supply known to modern science, and it is a surprise that the engineers of eastern railroads have not given the subject more thought and consideration, especially as the geological formation of the eastern country is such that it admits of obtaining a reliable supply in almost every instance, and the cost of a well usually is not more than one year's expense for water from ordinary sources, thus admitting of a saving of each subsequent annual water tax. The large number of tank stations incidental to the railroads centering in New York, naturally make the annual expense for water a heavy item of maintenance, and the saving of same is worthy careful consideration and investigation.

Contractors Intelligence,

Reported by T. H. Boorman.

Engineering and Building Materials,

WHOLESALE PRICES.

New York, December 2, 1886.

IRON.

STRUCTURAL IRON.		
Angles	2.15c @	2.25c
" steel	2.45 @	2.60
Tees	2.50 @	2.60
Beams and channels, American	3.00 @	
Tank plates	2.25 @	2.35
Shell plates	2.50 @	2.60
Steel plates, Tank	2.70 @	2.75
WROUGHT-IRON PIPE. PITTSBURG.		
Butt welded, black ..... Discount		40
" " galvanized ..... "		30
Lap welded, black ..... "		52½
" " galvanized ..... "		35
Boiler tubes ..... "		45
RAILS.		
Steel (large lots at mill)	$34.00 @	$35.00
Old rails	22.25 @	23.00
Old rails, steel	22.00 @	23.00
R. R. spikes	2.15c @	2.20c
R. R. splice-plates	1.70 @	1.90
R. R. track bolts, square nuts	2.50 @	2.75
Barb-wire fencing, galvanized	3.85 @	3.90
" painted		4.00
Corrugated iron		
Nails		
Iron, per keg	1.95 @	2.00
Steel do.	2.10 @	2.20

METALS.

COPPER.		
Lake Superior	11.50 @	11.90
Other Brands	10.37	
LEAD.		
Com. Domestic	4.00 @	4.25
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	5.50 @	5.70

BRICK.

Cargoes (afloat)		
Choice Brands	7.75 @	8.00
Haverstraw ..... per M.	7.00 @	7.75
Fishkill	7.00 @	7.25
Up-River	6.75 @	7.00
Jerseys	6.25 @	6.75
Long Island		
Pale	4.75 @	5.00
FRONTS.		
Croton, red	13.00 @	15.00
" dark	13.00 @	15.00
" brown	12.00 @	14.00
Philadelphia pressed	27.00 @	28.00
Trenton "	27.00 @	28.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	85.00 @	130.00
" American	80.00 @	120.00
Fire brick	25.00 @	55.00
American, No. 1	30.00 @	35.00
" No. 2	25.00 @	30.00

ASPHALT.

ROCK.		
French, per ton	$22.00 @	25.00
German	15.00 @	20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50 @	$3.00

LIME.

Rocklock Cement Co.'s Ground	.80	
Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.85 @	.90
" finishing	1.05 @	1.10
Kingston, ground	.90	
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95 @	1.00
" " No. 2 "	0.75 @	0.85
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
" " "		
Berea "		
Brown stone, Portland, Ct. "	1.00 @	1.35
" Belleville, N. J. "	0.75 @	1.35
Granite, rough	0.45 @	1.25
Common building stone per load	2.00 @	3.00
Sawed stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00
Concrete and macadam stone, Tomkins Cove, per cub. yd		$1.65

SLATE.

Purple roofing per square	5.00 @	6.00
Green "	5.00 @	6.00
Red "	10.00	
Black Penna. (at New York) "	3.50 @	4.00

LUMBER.

Prices for yard delivery in New York.

Pine, Common box per M.	18.00 @	20.00
Choice "	65.00 @	70.00
Tally plank, 1¼ in. 10 in. dress'd, each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	14.00 @	18.00
HEMLOCK, Boards each.	.14 @	.16
Joist, 2½ × 4 to 4 × 6 in	.16 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	25.00 @	30.00
Dressed flooring "	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75 @	6.00
LATH, Cargo rate "	2.25 @	2.30

PAINT.

Lead, white, American dry per lb	.04¾ @	.06¼
" " in oil pure	.07 @	.07½
" English, B. B. in oil	.08¼ @	.08¾
" Red, American	.06½ @	.07
Litharge "	05½ @	.06
Venetian red, American "	.01 @	.01¼
Indian red "	.08 @	.10
Vermillion, American lead "	.10½ @	.11¾
Paris green "	.15 @	.18
Umber, Amer. raw and powdered per lb.	.01¼ @	.01¾
Drop black, Amer.	.07 @	.13
" " Eng.	.11 @	.13
Chrome green	.10 @	.25
Oxide zinc, American	.03½ @	.03¾
" French	.06½ @	.07½

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:		
"Old Newark Co's." Cement		$1.10
BAETJER & MEYERSTEIN:		
Hanover Portland	$2.60 @	$2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
Burham	2.25 @	2.50
Fowler	2.25 @	2.50
BROOKS, SHOOBRIDGE & Co.	2.45 @	2.60
FISHER, EBSKINE W.:		
Stettin (German) Portland Cement	2.40 @	2.75
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.50 @	2.75
K. B. & S. " "	2.25 @	2.50
Stettiner, German	2.65 @	2.85
Lagerdorfer, "	2.45 @	2.75
Fieve, A 1, Belgian	2.35 @	2.50
Roman	2.75 @	3.00
Keene's Coarse	4.75 @	5.50
" Fine	7.75 @	8.50
" Superfine	8.50 @	10.00
HUDSON RIVER CEMENT CO. Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15 @	2.45
EMIL LENZ, New York.		
Stettin Portland	2.35 @	2.55
Fire-proof	1.75 @	1.95
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20 @	2.40
Improved "Union"	1.25 @	1.50
Union	1.10 @	1.20
NEW YORK CEMENT CO.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT CO.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
Alsen's Portland Cement Works	2.35 @	2.85
K. B. & S.	2.25 @	2.50
STANDARD CEMENT CO		
E. THIELE:		
Dyckerhoff	2.90 @	3.25
UNITED STATES CEMENT CO.:		
English Portland	2.25 @	2.40
German "	2.00 @	2.15
Standard	1.50 @	1.65
Windsor and Improved Rosendale	1.00 @	1.10
UNION AKRON CEMENT CO.:		
Akron "Star" brand	1.00 @	1.10

MARKET SUMMARY.

Brick are in good demand at about last week's prices, Choice Haverstraws sell at $7.75@$8.00 per M., Firsts $7.50@$7.75, Seconds at $7.00@$7.25; Up-Rivers are worth $6.75@$7.12½ per M., with Fishkills $7.00@7.25 per M.; Jerseys are quoted at $6.25@$6.75 per M., and Hackensacks find a steady sale at $7.00@$7.37½, with free arrivals. Pale have not been in much demand this week and rather drag at $4.75@$5.00 per M., Fronts are firm and manufacturers report they are kept busy in keeping up with orders. Rosendale Cement is firm at $1.10 and actively inquired for, a rise of 10c. per barrel is to be shortly anticipated, possibly before the close of navigation. Portland Cement has sold in large quantities, but principally on Southern orders. Lime attracts little attention and no change in price is anticipated from quotations of $1.00 for common Rockland, $1.20 for finishing. Plaster is in fair demand at $1.20 for ordinary city and for St. John, with some slight discount on the latter for export orders. The Lumber Market remains steady as to prices, the building demand continues good and good schedules of Spruce are readily placed at $14.00@$17.00 per M., with extra at $18.00 for extra sizes. Lath have arrived very freely, and very large quantities are reported sold at $2.25 per M., with some sales at $2.20 per M. Yellow Pine is unchanged in value, with a good market reported. White Pine S. A. shippers, $28.00@$29.00 per M., West Indian shippers, $16.00@$17.00, and Box boards, $14.00@$15.00 per M. Paints and Oils quiet and unchanged in value. Turpentine is dull, and price down to 36c. per gallon. Lead is quiet, but market firm at 4.40c. Tin has experienced a slight advance in price here and abroad, quotations are: Straits, 22.65c @22.70c. in 5@10-ton lots, 22.85c.@22.90c. for store lots, Banca nominal at 23. Tin Plate is quiet, and prices hardly steady at prices quoted last week. The Hardware Market is not one of activity, and the hand-to-mouth policy continues prevalent. Nails seem to have at last a slightly upward tendency, and $2.00 seems now to be a fair quotation. Sheet Zinc is in good demand with prices ruling at 5½c.@5¾c., according to brand and size of invoice. Tar and Pitch are in only moderate demand at "combination" prices, with discounts according to quantities and delivery.

BUILDING ITEMS.

The Twentieth Annual Convention of the American Institute of Architects was held this week in this city. The opening address of welcome was delivered in the Directors' room of the New York Mutual Life Insurance Co., Nassau and Cedar streets, by the President of the Institute, Thos. U. Walter, of Philadelphia. The sessions were attended by a large number of architects from other cities, and a number of interesting papers were read and matters of interest to the profession discussed.

The Armory Commissioners in accepting the plans of Messrs. Geo. B. Post and J. R. Thomas for the new armories, stipulate that no commission is to be paid to either architect should the cost of the building exceed the estimated cost.

Messrs. A. Zucker & Co. have drawn plans for a five-story store, 50 feet front, to be either iron or brick and stone, to be erected for Mr. I. Cohnfeld at Nos. 159 and 161 Greene street.

The Health Department will receive estimates until December 9th for the erection of a brick Morgue on North Brothers Island.

Mr. Wm. Baker is the architect for the St. Charles family hotel, which is to be erected on the north side of Twenty-seventh street, east of Sixth avenue, by Mr. Chas. A. Gerlach for a syndicate. The cost is estimated at $400,000. The building will cover a lot 10 feet square, ten stories high with basement and cellar and will be fireproof throughout. The three lower stories are to be limestone and above brick with stone trimmings.

Mr. W. H. Hume has been appointed architect for the improvements to be made to B. Altman & Co.'s store on the corner of Nineteenth street and Sixth avenue. These will embrace the extension on the rear, about 100 feet to Eighteenth street and double the size of the building on Sixth avenue. The cost of the improvements will be about $200,000.

Mr. J. B. Snook has designed for the N. Y. Central Sleeping Car Co. several workshops, to be erected for them at East Buffalo, N. Y., at a cost of about $75,000.

Mr. Albert Wagner has prepared plans for alterations to be made to the factory of Wm. Wicke & Co., 401 to 421 East Thirty-first street, to cost $8,000.

Mr. James Stroud has designed for Mr. J. R. Planten a six-story brick factory building, 21.10x89, to be built at No. 231 William street, at a cost of about $20,000.

Mr. H. Edwards Ficken has prepared plans for a four-story brick residence, 20x68.8, to be erected for Mrs. Francis A. Johnson, Islip, N. Y., at a cost of $25,000 on the north side of Eighty-first street, 297 feet west of Ninth avenue.

Messrs. J. Bockell & Son have drawn plans for a six-story brick factory, 25x82, to be built at No. 108 West Eighteenth street, for Mr. Geo. Heyman, at a cost of $18,000.

Messrs. D & J. Jardine have on the boards plans for a four-story and basement brick and brownstone residence, 18x70 with extension, to be built for Dr. John T. Metcalfe at No. 147 West Fifty-seventh street, at an estimated cost of about $25,000.

Mr. John C. Burne is preparing plans for five five-story brick, stone and terra-cotta flats, 25x60, to be built for Louis Rossi on the southwest corner of Ninth avenue and One Hundred and third street, to cost $110,000.

Mr. F. A. Minuth is the architect for a five-story buff brick and terra-cotta flat and store, 25.2x96, to be built for Mr. John K. McKee on the southwest corner of One Hundred and Sixth street and Third avenue, to cost $23,000.

Mr. J. H. Valentine, 58 Liberty street, has on the boards plans for a five-story brick and brown stone flat and store, to be built for John Flanagan on the southwest corner of Eighth avenue and One Hundred and Thirteenth street, at a cost of $20,000.

Messrs. A. B. Ogden & Son have on hand plans for two six-story brick and terra-cotta front stores, 25x80, to be built at a cost of $50,000 at Nos. 83 and 85 Elizabeth street.

Mr. A. Page Brown, 57 Broadway, is the architect for a lodge watch tower, to be built for Spencer Trask at a cost of $5,000 at Saratoga Springs, also for a library building for the Thornwall Orphanage at Clinton, S. C., cost of which is not yet estimated.

Mr. Max Schroff is the architect for a six-story brick and iron warehouse, 25x70, on Crosby street, near Houston, which is to cost about $26,000.

Mr. Anthony Pfund has made the necessary plans for alterations into a stable and tenement of the storage building on the northwest corner of Albany and Washington streets, for P. Ballantine & Son, of Newark, cost of which will be about $10,000.

Mr. Anthony McReynold will build on a lot, 100x100, six three story brown stone front residences on the south side of One Hundred and Forty-first street, 100 feet east of Edgecombe avenue.

BROOKLYN.—Last week permits were granted for sixty-three new buildings valued at $235,480, the more important were;

On the corner of Hancock street and Sumner avenue, Mr. E. H. Wells is building a four-story brick house, 20x55, for a store and three families, to cost $10,000.

At 186 Fort Greene place Messrs. Armour & Co. are erecting two brick buildings for an ice house, 48.3x69, at a cost of $9,000.

On Hancock street, west of Lewis avenue, Mr. J. C. Bushfield is building two three-story and basement brownstone front private residences, 20x47, at a cost of $16,000.

On Hancock street, east of Nostrand avenue, Mr. Harman Phillips is building eight three-story and basement private residences, 20x45, at a cost of $56,000.

On Fifth avenue, south of Sixteenth street, Messrs. J. H. Doherty & Bro., are building two four-story brownstone front houses, 21x62, for a store and three families, to cost $20,000.

On Hancock street, east of Sumner avenue, Mr. H. E. Wells, is building six two-story and basement brick private residences, 17.6x42, at a cost of $30,000.

Mr. Lawrence J. O'Connor is engaged on plans for the new Roman Catholic church of St. Francis, which is to replace the one burned down last Sunday at Mt. Kisco, N. Y.; cost about $6,000; he has also drawn plans for the Rev. Michael Lane for a Roman Catholic church, to be built at Rye, N. Y.; to cost $10,000.